Announcing
RTE Food Packaging Seminar 2016
RTE to launch in-depth UV/EB market survey

Reporting
RTE Conference & Exhibition 2015
General Assembly 2015
IPA EB Seminar 2015

News from the Industry

Update
REACH
Calendar of Events

February 2016
24-25  Label & Print 2016  Utrecht, The Netherlands
24-25  Packaging Innovations 2016  Birmingham, UK
24-25  Inside 3D Printing  Düsseldorf, Germany

March 2016
8-11  FESPA Digital 2016/European Sign Expo  Amsterdam, The Netherlands
22-24  Eurocoat  Paris, France

April 2016
5-7  LOPEC Printed Electronics, Messe  München, Germany
12-14  Empack 2016  Utrecht, The Netherlands
19-22  PaintExpo 2016  Birmingham, UK
27-28  3D Printing Europe 2016/Printed Electronics Europe 2016  Berlin, Germany

May 2016
16-18  RadTech 2016 (North America)  Chicago, Illinois, USA
24-25  Surfex 2016  Birmingham, UK

June 2016
1-10  Drupa 2016  Düsseldorf, Germany
16-18  FINAT European Label Forum 2016  Amsterdam, The Netherlands
28-30  Additive Manufacturing Europe 2016  Amsterdam, The Netherlands

September 2016
11-14  ESPS 2016  Leipzig, Germany

October 2016
5-6  Inkjet Conference 2016  Düsseldorf, Germany
19-20  Fogra UV Printing User Forum  München, Germany
13  RTE General Assembly 2016  Frankfurt, Germany
14  RTE Food Packaging Seminar 2016  Frankfurt, Germany

December 2016
6-9  Plastics and Paper in Contact with Foodstuffs 2016  Brussels, Belgium

RTE Advertisement: Low priced deals for high exposure in industry

Advertising in RTE RadFlash (e-newsletter)
Place a static banner (630 x 150 pixels) in the monthly online e-newsletter of RadTech Europe. Only € 100,- for placement in one issue and € 1.000,- for one whole year (12 editions)!

Online advertising on RTE website
The RadTech Europe website (www.radtech-europe.com) is the go-to source for the European UV and EB industry. On average, the site attracts 5,000 pageviews on average divided over 1,400 visitor sessions on average per month. In the months surrounding the RadTech Europe Conference & Exhibition or other leading projects, the RTE site attracted nearly 2,500 visitors per month. A lot of this traffic is generated by registered visitors, potential RTE members that remain updated on RTE’s activities through regular newslashes. Your company’s digital advertising reaches all those directly involved in, associated with, and even just interested in, the UV/EB Technology.

NEW: Business Case
With the new and improved RTE website launched in October 2011, RTE offers a whole new way of advertising. If you are a RTE member and you are interested in more exposure for your company’s latest developments/products, make use of the Business Case on our website! You get a full page on the RTE website, together with short summary which will be featured prominently on the home page and related industry pages, giving you maximum exposure on the relevant parts of the website. Ask the Secretariat for more information.

Advertising in RTE News
RadTech Europe offers members and non members the possibility to place an advertisement in the RadTech News. Prices per issue: € 1.500,- for 1 full colour page and € 750,- for a ½ full colour page. All advertisers taking up an advertisement in one or more issues of RadTech News will get the opportunity to add one page editorial space in the magazine. The article should be of general interest to our readership.

If you are interested please contact the Secretariat at mail@radtech-europe.com or find more detailed information in the Advertisement & Media Rates 2016 brochure on http://www.radtech-europe.com

| Media Rates |
|-----------------|---------|-----------------|
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| 1 page per issue (full colour) | € 1,500,- | € 3,000,- |
| ½ page per issue (full colour) | € 750,- | € 1,500,- |

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  € 250,- - members only -

- **Per Quarter**
  € 500,- - members only -

- **One year**
  € 1,000,- - members only -

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Word of the President

In an ever-evolving landscape, we as an industry and RadTech Europe as an association have to adapt. For this, we need you.

Increasingly rapid changes in legislation, ranging from RoHS to food contact legislation mean we need to be in closer contact with each other, end-users and authorities. Open communication and participation are key to create a greater understanding and ensure our interests are taken into account. Similarly, technological advancements mean new potential applications and markets, who still have to learn of the benefits of our technology, as well as be educated on its proper use.

In this landscape, one voice for our industry and our combined strength is needed to face the challenges and identify or create new opportunities. That bringing together of interests, resources and knowledge to bring our industry forward, that is what our association can bring to the table, but we need your help!

You, better than anyone, know the issues your company is faced with on a day-to-day basis, the opportunities out there and the support you need from us. Share your insights and expertise. Take a seat in one of the working groups to tackle the challenges.

You also know the things you appreciate in RTE and the things you would like to see changed, so let us know by responding to our recently-issued member survey! RadTech Europe is a living organization, keen to meet your needs and expectations and ready to change to do so.

A number of new initiatives are already in the works, including an upcoming recurring comprehensive market survey to generate exclusive market insights for our members, as well as on-going discussions to further improve our events and engage members and end-users.

We are looking forward to working with and for you.

Yours sincerely,

David Helsby
President RadTech Europe

New members of RadTech Europe in 2015

New company members
Domino U.K. Ltd
Martin Thompson
United Kingdom
David Thomson
United Kingdom
Akcros Chemicals Ltd
Edward Wihardja
Vietnam
Filip Rickard
Sweden
Edson International
Tonnie Teglenhof
The Netherlands
Saint-Gobain Ecophon AB
Oude Koehorst
Sweden
Nedap Light Controls

New individual members
Coloplast A/S
Carsten Hoj
United States
Alexander Link
Germany
Heraeus Noblelight GmbH
Sven Schalk
United States
Yi Zhao
China
Heraeus Noblelight GmbH
Detyf Burgard
United States
Heraeus Noblelight GmbH
Ahmet Nebioglu
United States
Dymax Corporation
Felix Keller
Switzerland
Dymax Corporation
Andreas Stabla
Liechtenstein
Radlab AG
PCT Engineered Systems, LLC
K. Swanson
United States
Schekolin AG

New affiliated members
UWAVE
Fraunhofer Institute for Organic Electronics, Electron Beam Association of organizations and professionals in radiation

RadTech Europe welcomes all new members!
If proof were needed, last year’s RadTech Europe Conference in Prague (CZ) certainly proved how dynamic and diversified the world of radiation curing is today. For the benefit of some 440 delegates, 60 speakers addressed the plethora of chemistries, technologies, and applications that today employ UV and EB curing, in an intense and wide-ranging programme – in a new, more technically-focussed format, and held at a new location. The formal agenda was partnered by a parallel exhibition featuring leading technology providers – incorporating a small theatre where exhibitors could introduce their latest products – which provided an excellent context both for delegate networking and for business discussions.

New location
Prague’s Clarion Congress Hotel was the chosen hub, which proved to be an ideal combination of spacious first-class conference/exhibition facilities with – on site – the comforts of an international hotel. The change of venue was just the outward demonstration of the new face of the conference, which was headlined UV/EB Now: new place, new format, new applications. RadTech Europe’s President, David Helsby, RAHN AG (CH), explained the association’s mission as ‘to create an event that, in every respect, provides real value for the delegates.’

Proceedings commenced with the members-only RadTech Europe General Assembly, which was, says David Helsby, ‘lively, very well attended, and proof of the commitment of the members of the existing working groups. We’re keen to create new working groups, and will welcome members’ proposals on potential appropriate subjects, as well as offers of participation from willing members!’

Conference keynote
Following the AGM, conference chairman Dawn Skinner of Heraeus Noblelight America LLC (UK) opened the plenary conference session. It featured a challenging, thought-provoking keynote from Lars Søndereger of behavioral management specialists Quantonomics (CH) on the key topic of the most effective routes to innovation and value creation.

He showed how our current digitally-enabled era has only added complexity to our decision making, leaving us with less time to actually define appropriate solutions to life challenges. He advocated developing a strategy, based on behavioral science, on how you, your team, and everybody in the company interacts. ‘The human brain is a social brain, with biological wiring which works better when it collaborates with other people,’ he explained. We need to get connected in person, as well as digitally, because the chemistry of person-to-person contact is different from that involved in making contact via mobile phones or videoconferencing. Facial expressions, posture, talking, listening, simply being together, all combine to create an environment that is the basis for learning, sharing, defining real needs and wants and, of course, ultimately mapping the path to innovation. ‘The higher the alignment is, the higher will be the innovation and therefore success rate!’, he emphasized.

US market overview
It was time to review innovations and developments in the US market, and Gary Cohen, of RadTech North America (US) explored the many innovations in the radiation curing market which are creating the expectation of a CAGR for the industry of more than twice US GDP for the next three years, and a growth rate of more than 7% over the next two years for the current up-and-coming applications – 3D printing, inkjet, and fingernail decoration.

European market overview
The world total for radiation-cured finished products today is an estimated 520 thousand metric tonnes, David Helsby said, as he began his evaluation of European market developments. He confirmed that the DACH region is still Europe’s largest consumer of UV/EB technologies, representing 42% of the market. Identifying major trends, he examined the raft of regulatory compliance requirements, observing that those of the end-user companies – eg Nestlé, TetraPak, and IKEA – are in fact stronger than the formal EU legislation. What, he wondered, ‘will come next in the way of requirements and regulations?’, and how will the unpredictable issues – crude oil prices, raw material costs, freight, interest rates, currency – affect the industry?

Award winners
The plenary session concluded with RadTech Europe prize presentations conducted by the President. The long-established, prestigious Paul Dufour Award for the best conference paper was awarded to Sandra Schlögl of the Polymer Competence Center, Leoben (AT) for her paper on the formation of 3D structures in offset printing techniques by UV induced ink foaming. Simone Radl, also from the Polymer Competence Center, Leoben, was presented with the RadTech Europe Advanced Development Award 2015, for her ground-breaking presentation on smart photoswitchable composite materials for self-healing and recycling strategies.

Parallel programmes
An impressive succession of parallel programmes then split the delegate base into different streams for the remainder of the three days, covering advances in photochemistry and polymerization; developments in printing technology; HSE and the safe use of UV/EB; advances in UV LED technology; 3D printing; innovations in applications; developments in coatings and formulations; innovations in chemistry
and materials; and advances in UV/EB equipment and process control.

‘The depth and diversity of the subjects addressed by the expert speaker base are testimony to an industry that is a real centre for innovation and growth,’ said David Helsby. ‘The more technical face of the conference has unquestionably created huge interest – as the considerable growth in the delegate base, spanning industry and academe, confirms.’

**Legislative matters**
Legislation – particularly REACH – figures strongly in the radiation curing industry’s agenda today. Dr Didier Vanhoye of Sartomer (FR) (a company which is a member of the REACH Polymerisable Acrylate Resins and Derivatives Consortium) – provided an update on tier 1 and 2 registrations of (meth)acrylic monomers, their evaluation, the main remaining issues prior to tier 3 registration, and potential industry impacts. Legislation around hazardous goods transportation, packaging materials for food contact and UV inks for food packaging, mercury exemption status under RoHS, and Bisphenol-A were also discussed in an informative session chaired by Andy Boon of Sun Chemical (UK).

**Photochemistry and photopolymerization**
The key areas of photochemistry and photopolymerization brought together a number of specialist papers from European experts. Joint chairman Xavier Allonas, Université de Haute Alsace (FR), and Prof Marco Sangermano, Politecnico di Torino (IT) introduced in-depth studies of aspects of photoinitiators, photopolymerization, and the use of CTAs.

**Developments in printing technology**
Printing technology has been a key development arena for UV curing in recent years, and in the dedicated conference session chaired by Nick Ivory, Sun Chemical (UK), Sandra Schloegl’s award-winning paper on UV induced ink foaming for the formation of 3D structures in offset printing was joined by explorations of EB-curable CI-flexo ink for sustainable packaging print; water-based UV inkjet; controlling the variables in UV LED curing in low-migration printing; UV LED curing formulations for inks and coatings; and the state of the art in UV inkjet print on food packaging.

**UV LED**
UV LED technology was the focus of the session chaired by Paul Kelly of Perstorp (UK), which attracted extremely high attendance – evidence of the considerable activity and interest in this particular field. Content spanned new resin and formulation developments; improved surface cure with deep-UVC LEDs; the impact on UV curing applications of advances in UV LED technology; developments in UV LED equipment; and solutions to enhance the performance of UV LED and low-energy-curable systems.

**3D printing**
The session on 3D printing/additive manufacturing, chaired by Susanne Piontek, BASF Coatings (DE), opened with an overview of the history and status quo from the 3D Printing Association’s membership director Ian Ferguson (UK). He asked: ‘Will every home have a consumer 3D printer within the next ten years?’ answering ‘Some say yes!’.

However, growth drivers in mainstream industry are now clear to see, he showed: on-demand manufacturing and speed to market, from idea to product, but some challenges remain – particularly achievable printing speeds and materials diversity. The conference session went on to record developments in different aspects of 3D UV inkjet printing and exciting advances in photopolymerization for human tissue engineering.

**Innovation in applications**
The field of medicine featured again in the session covering innovation in applications, chaired by Massimo Cattaneo of IGT Resins (IT). Photopolymerized adhesives for wound seals in biological tissues were the opening topic, and the session also covered a review of globally-competitive Russian radiation technologies, photocured encapsulant for photovoltaic panels; and smart ‘photoswitchable’ self-healing composite materials. Proving that radiation curing is not just a technology for today’s technologies, the session closed with a paper on preserving 19th-century documents on paper by stabilizing the acid pH of the wood pulp.

**Chemistry and materials innovation**
Innovation in chemistry and materials are at the very heart of the radiation curing industry, and a dedicated session, chaired by Stephan Peeters of Allnex (BE) documented several routes to future success. Papers covered the production of thermoset fibres using UV curing; a UV-activated hydrosilation reaction for silicone polymer crosslinking; UV switchable crosslinks in rubber materials; dual-cure polymerization of acrylates – successfully applied in the fabrication of carbon fibre composites using LED irradiation; renewable itaconic acid-derived binder vehicles used in radical UV/EB curing; and electron beam induced graft copolymerization.

**Coatings and specialist formulations**
Coatings and specialist formulations are also an area of particular current interest, and Christophe Vergé of Sartomer (FR) chaired a session that highlighted recent developments. Soft-touch coatings that are 100% UV-curable; self-replenishing...
An all-round success - the attendees' verdict

**Mark Macaré**, Secretary-General of RadTech Europe, commented on the ‘new look’ 2015 conference: ‘We are delighted to see that our choices for the new format have paid off. Not only did the event attract nearly 40% more participants compared to the last edition, but it also garnered overwhelmingly positive feedback from the attendees.’

**David Helsby** agreed, saying: ‘I have received a huge amount of feedback from people who really enjoyed this year’s conference and found it exciting. The new format has certainly rekindled participants’ interest’

**David Engberg, Perstorp AB (SE):** ‘Thank you for a very good conference. It was my first time, and I was extremely pleased with my visit. There were a lot of very interesting presentations that gave a very good insight on what is going on in the industry. I was also impressed with the openness of all participants and how easy it was to connect with people in an informal way -- and still be able to have very fruitful discussions!’

**David Harbourne, Heraeus Noblelight America:** ‘Congratulations on a very successful Radtech Europe 2015. The new, rejuvenated, format was much appreciated by the participants.’

Networking, socializing

Foto 5 Socialising and networking also characterised the event; and the conference arena hosted the ‘afterwork party’, with excellent live jazz, at the end of the first day, and breaks throughout the formal programme. On the second evening, delegates enjoyed a delightful dinner at the glorious Plenszka restaurant in Prague’s city centre.

Event sponsors

Europe’s 2015 event for UV/EB curing was sponsored by many leading companies; gold sponsors Allnex, Arkema, BASF, BYK, DSM Coatings Resins, Dymax, Heraeus Noblelight, IGM Resins, Lambson, Rahn, and silver sponsors Nedap Light Controls, Opsytec Dr Groebel, PCT Engineered Systems, and Siltech. The event was also supported by media partners whose publications are key disseminators of news on the radiation curing industry, in many fields of application.
General Assembly report

The first day of the Conference and Exhibition in Prague was preceded by the RadTech Europe General Assembly. The Assembly was reopened as a special General Assembly by President David Helsby as quorum was not met.

Report on activities

Mr. Helsby highlighted the events of the association in 2014 and 2015. 2014 saw another highly successful edition of the RadTech Europe Food Packaging seminar in Stuttgart, attracting nearly 90 people. Concerning external events, Mr. Mark Macaré, Secretary-General of the association had given a presentation at the Polish Flexography Association on the safe use of UV and EB for food packaging. RTE had also been present at the PIRA Food Packaging seminar.

RadTech Europe Conference and Exhibition 2015

Mr. Helsby noted the changes in the new Conference and Exhibition, the first of which was the organization, which was now run by the Secretariat of RadTech Europe, giving the association full control over the event. Likewise, the streamlined program gave the Conference Committee the opportunity to be more selective in accepting papers, as well as offering breakout sessions on topics of particular interest. The goal of the scaled-down exhibition was to offer visitors and exhibitors resource-efficient networking opportunities, a fact supported by the fact that the event was hosted under one roof in a conference hotel.

Further activities 2015

Aside from the Conference, Mr. Helsby noted, RadTech Europe had been active in various other areas. Closer cooperation with RadTech North America had been developing for a number of years and remained one of important area of focus for the association, as did closer ties with other (end-user) associations.

In the area of public affairs and Health, Safety and Environment, there was no lack of topics of interest, with REACH, the application for the RoHS mercury exemption extension and the start of the revision of the reference document for best available technologies for surface treatment using solvents all items in which RTE was involved.

Finally, the association had already started preparations for the next Food Packaging seminar in 2016, scheduled for 30 September in Dusseldorf. In November 2015, a joint event together with the International Packaging Association would take place in Murcia.

Relations with contracted partners

A notable change in partners was the termination of the partnership with Vincentz Network. Instead, the RTE Secretariat, run by Lejeune Association Management, was also in charge of the organization of the RadTech Europe Conference.

Mr. Helsby closed with a look at the RTE membership. He noted an increase in members for the first time in 2007, once again highlighting the fact that most of the decline reflected the mergers and acquisitions in the industry. A dedicated membership drive would be developed by the Marketing Committee to buck the trend.

Report on the committees and working groups

Marketing Committee

Mr. Mark Macaré covered the work by the Marketing Committee. To strengthen the role of knowledge provider, the functionality of the knowledge center had been expanded to allow for easier searching of articles. In addition, new books had been added to the RadTech Europe bookstore.

The Committee had also provided valuable input for articles on the Conference and 3D printing. Finally, the association had participated at a number of key events, including Labelexpo, the European Coatings Show and PIRA Food contact conference.

For 2016, a primary focus would be a membership drive. As a first step, a member survey would be developed to identify current strengths and weaknesses of the association. This input would serve as the basis for a strategy to increase membership and retain old members. In terms of education, the Marketing Committee would look to participate in end-user events as well as organize RadTech Europe events to enlarge interaction with end-users.

HSE Committee

The HSE committee had been strengthening ties with a number of important groups, including the CEFIC UV/EB acrylates group, EuPIA and RadTech North America. In the area of food contact, cooperation with EuPIA was on-going to compile dossiers for submission to the Swiss authorities for a number of common photoinitiators. Furthermore, coordination of REACH registration efforts were on-going to identify if all substances of interest were covered. For 2016, these topics would continue to be of importance.

EB working group

While the originally scheduled EB seminar had been canceled, the working group was providing support for an external electron beam seminar in November.

Metal coating working group

While the metal coating working group had been relatively quiet in 2015, it had provided important support for the external EB seminar scheduled for November. The working group would come together to discuss the way forward in 2016.

Graphic Arts working group

The Graphic Arts working group had already started preparations for the next food packaging seminar, scheduled for 2016. This would intensify in the coming months with the goal of having a full program end of quarter 1 2016. Mr. Macaré underlined that RadTech Europe was open to ideas for new working groups. Members were encouraged to come forward if they had identified an area or application where the association could be of help.

Finances

Going through the numbers for 2014, Mr. Macaré noted that the final result was -36,744 euro, better than what was initially budgeted as income of the seminar had been significantly higher. The report was approved unanimously. For 2015, the final result was projected to be 77,465 euro, nearly 15,000 euro lower.
than budgeted, due to lower income for the congress.
The budget for 2016 was in line with the budget for 2014, with a budgeted final result of -47.910 euro, leaving the association with 280.868 euro in reserve at the end of the year. This was approved unanimously by the attendees. Membership fees would remain the same. Mr. Macaré ended the General Assembly with the proposed Management Committee composition for 2016, which was:

- President Mr. David Helsby RAHN
- Vice-President Mrs. Audrey de Wulf Allnex
- Secretary Barbara Fenzi Lamberti
- Treasurer Mrs Caroline Bastien Sartomer
- MC member Vacancy
- MC member Mr. Nick Gruber BASF
- MC member Mrs. Dawn Skinner Hereaus Noblelight
- MC member Mr. Arnd Riekenbrauck IST Metz
- MC member Mr. Nick Ivory EuPIA

This was approved unanimously.

IPA EB seminar

While the majority of attention was taken up by the RadTech Europe Conference and Exhibition 2015 (see the full report elsewhere in this magazine, another RTE-supported event took place in November 2015.

The International Packaging Association decided to dedicate one day of their Technical Committee meeting to learn more about the use of electron beam for metal coatings. The association, with membership of CEOs of independent canmakers around the world, welcomed the support of our association to provide technical expertise.

In the one-day seminar, representatives of the EB and Metal Coating working groups covered the gamut of topics concerning EB for metal substrates, ranging from chemistry to legal requirements. Participants highly appreciated the open discussions, while we as RadTech Europe welcomed the opportunity to interact directly with end-users.

Given the positive feedback, RadTech Europe is open for similar initiatives and to support other end-user associations with technical expertise.

4th European Symposium of Photopolymer Science (ESPS 2016)

The 4th European Symposium of Photopolymer Science will be held in Leipzig, Germany, from September 11-14, 2016. ESPS 2016 is the follow-up meeting of a series of previous, very successful ESPS meetings in Mulhouse (2010), Torino (2012), and Vienna (2014). The objective of the symposium is to provide a fruitful platform for cross-disciplinary exchange on cutting-edge developments in the field of photopolymerization. It aims to bring together experts from both academia and industry in order to communicate their latest results. The meeting will cover all aspects of photopolymerization such as the fundamental understanding of initiation and polymerization reactions, photopolymerization kinetics, photoinitiator and monomer synthesis, new analytical methods, structure-property relations as well as applications in established and emerging fields. The program of the conference will be mainly based on 21 invited talks given by leading scientists from Europe, America and Asia working in the field of photopolymer science. In addition, oral presentations as well as posters will be accepted. Abstracts for lectures must be submitted until March 31, abstracts for posters can submitted also after this date. Early bird rates for registration are available until April 29. More detailed information about ESPS 2016 is given at the conference website: www.esps2016.de.
Abstract of winning paper Radtech Europe Advanced Development Award 2015

SELFHEALING AND RECYCLING STRATEGIES

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In this contribution, we present new approaches towards the preparation of composite materials with tunable mechanical properties. By introducing photo cleavable crosslinks into thermosetting resin smart composite materials with photoswitchable mechanical properties are obtained. Due to the photoinduced cleavage reaction of the o-nitrobenzyl ester groups a distinctive decrease of the storage modulus and the glass transition temperature of the cured resin and enhanced recyclability is confirmed by several methods.

The work further aims at the preparation of thermosetting resins bearing UV sensitive anthracene moieties. Upon UV irradiation a crosslinking of anthracene groups in the resin is achieved, whilst a subsequent thermal step leads to a cleavage of the dimer. In order to evaluate the ability of the cured resins to recover their mechanical properties upon several bond formation and scission cycles, dynamic mechanical analysis and three-point bending tests were performed. The results indicate the repeated healability of the photocrosslinked materials with healing efficiencies of 30% and 70% in terms of storage modulus and flexural stress.

Abstract of best conference paper 2015

FORMATION OF 3D STRUCTURES IN OFFSET PRINTING TECHNIQUES BY UV INDUCED FOAMING OF INKS

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Coauthors: Martin Reischl, Volker Ribitsch, and Wolfgang Kern.

The present work addresses the formation of 3D structures via UV assisted foaming of commercially available acrylic offset inks. The microcellular foaming relies on the excitation of selected photoacid generators with UV light to release Brønsted acids. Once formed, the acids react with calcium carbonate particles under the release of carbon dioxide that is employed as blowing agent. To obtain a higher exploitation of the emission light and thus a higher level of acid formation, photosensitizers are added to the ink formulation. With optimized process parameters, the relative thickness of the expanded ink layer exceeds 90% with a corresponding cell diameter in the range of 10 to 15 μm. The results give evidence that the UV induced foaming represents a promising approach towards the one step production of three dimensional patterns in offset printing techniques.[1]

New Oligomers for 3D Printing Inks

Written By Heather Francis & Ahmet Nebioglu
Dymax Corporation
Torrington, CT USA

Abstract
The present work addresses a strong market demand for oligomers for 3D printing formulations. Structure-property relationships in a new family of oligomers will be discussed. Effect of oligomers on oxygen inhibition, coefficient of thermal expansion, heat distortion temperature, shrinkage, and color stability will be revealed. Some of the formulations based on the various new oligomers are very fast curing and prone to substantially less oxygen inhibition. They demonstrate good adhesion to different substrates and possess very low water absorption characteristics.

Introduction
3D printing uses additive manufacturing processes that use gradual creation or addition of materials to form an object. 3D printing has become a widely used method for manufacturing prototypes in many industries, including automotive, aerospace, consumer goods, and medical device, since it produces prototypes with complex shapes relatively quickly and at a significantly lower cost than traditional methods.

There are a number of different 3D printing methods but the most common 3D printing methods that use light to form the desired 3D shapes are stereolithography (SLA), UV inkjet, and digital light processing (DLP).

- **SLA** – SLA uses a UV laser to crosslink a liquid resin in a specific area with a specific depth. Once the first layer of the desired object is formed, it is lowered and the liquid resin is reapplied on top of it. Successive curing of layers will form the desired object with high precision.

- **UV Inkjet** – The 3D UV inkjet printing method works similar to a 2D UV inkjet printer. Instead of printing on paper, successive layers are printed and cured on top of the previous layer.

- **DLP** – DLP uses a digital light projector to project a 2D image and cure the resin. Successive curing of the 2D images form the 3D shape desired. Compared to the other methods, the light irradiance used in DLP is significantly lower.

Replacing traditional mass manufacturing processes with 3D printing is very appealing from a commercial perspective, especially in applications where only relatively small number of parts are required. Unfortunately, there are several challenges preventing the realization of this potential; speed of manufacturing and meeting the material performance properties are the most important ones. From a materials perspective, it has been a challenge to match the performance of common plastics like PC and ABS. It is often difficult to match deformation resistance of plastics at elevated temperatures with thermoset materials. In this study we investigated oligomers used in the 3D printing industry and how to improve their heat distortion temperatures without having to significantly take away from other performance attributes.

Experimental
All oligomers were analyzed with gel permeation chromatography (Polymer Labs PL-GPC 50 equipped with RI detector and mixed D-columns and FTIR (Perkin Elmer Spectrum 100). Viscosities were measured using a Brookfield CAP 2000+ viscometer. The oligomers were tested for potential use in 3D printing applications using a simple model formula (Table 1). Formulations were mixed using a FlackTek DAC 150.1 FVZ SpeedMixer at 3,000 rpm for 2.5 minutes. For ease of testing and comparison, formulations were cast in single layer films where applicable. Such films could be viewed as corresponding to the individually cured layers of a fully 3D printed object.

Each formulation was cured with a Dymax UVCS Light-Curing Conveyor outfitted with 5000-EC Flood Lamps at an irradiance of 300 mW/cm² and 4,000 ml/cm² energy. The curing irradiance and energy were recorded using an ACCU-CAL™ 150 Radiometer.

The durometer hardness of each formulation was measured using ASTM D2240. Cure profiles of all formulations were analyzed by a Differential Scanning Calorimeter (DSC) equipped with a Dymax BlueWave® 200 Spot Lamp. After 30 seconds of isothermal stabilization at 25°C, samples were exposed to 50 mW/cm² UV irradiance for 15 seconds. Tensile properties were measured with an Instron according to ASTM D882. Thetal Analysis DMA Q800 was used to measure the heat deflection temperature (ASTM D648) and the glass transition temperature (ASTM E1640).

Results and Discussion
In general, polyurethane acrylates are used in 3D printing formulations primarily due to the toughness they provide. This toughness is critical in obtaining impact and scratch-resistant objects. Three different types of polyurethane acrylates were synthesized in order to investigate how the structure of polyurethane acrylates affects the critical properties needed for 3D printing resins. Representative structures of these polyurethane acrylate (PUA) oligomers are given in Figure 1. The first type is the most common type of PUA. The backbone contains soft and hard segments and acrylate groups are connected to the hard segment. In the second type, the acrylate group is directly connected to the soft segment. The third type of PUA has 3 acrylate functionality.

<table>
<thead>
<tr>
<th>(Meth)acrylate monomer</th>
<th>51.1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzoylformic acid methyl ester (MBF)</td>
<td>1.9%</td>
</tr>
<tr>
<td>Benzophenone</td>
<td>1.7%</td>
</tr>
<tr>
<td>(2,4,6-Trimethylbenzoyl)diphenylphosphine oxide (TPO)</td>
<td>0.3%</td>
</tr>
<tr>
<td>Oligomer</td>
<td>45.00%</td>
</tr>
</tbody>
</table>

Table 1. Model Formula
increased (despite the increase in SSR). 1A provided very good elongation due to its high SSR. It can be used as an additive oligomer in objects that require relatively high elongation rates.

From 1B to 1C, AR and SSR were increased by about the same factor, as a result the HDT of 1D was same as 1C even though it had higher SSR. Oligomer 1D had higher SSR, which resulted in a slightly higher elongation at break and a lower tensile modulus compared to 1C. It was interesting that the HDT of 1D was same as 1C even though it had higher SSR. Oligomers 1C and 1D gave the highest HDT. Both of them had high HSR and the highest acrylate amount (AR) containing Type 1 oligomers. This might be related to hard segments’ proximity to acrylate groups and hence hard segments’ proximity to crosslinks in the cured material. When the hard segments are closer to crosslinks it might be harder to distort the crosslinks and therefore result in higher HDT. Type 2 oligomers also provided higher tensile strength and lower linear shrinkage values compared to Type 1 oligomers. Lower shrinkage might be due to relatively less stress formation during curing due to hard segments’ proximity to the crosslinking site. Less stress build up in the material also affects tensile properties. An increase of HSR and AR and a decrease in SSR seem to increase HDT. Oligomer 2A is appealing due to very low shrinkage and good balance of tensile strength and elongation.

Table 1 shows the Type 1 oligomers’ structural description and viscosity of the model formula with the corresponding oligomer. Acrylate ratio is defined as the relative ratio of the acrylate groups within each oligomer. Soft segment ratio (SSR) and hard segment ratio (HSR) are relative length of the soft and hard segments of each oligomer respectively compared to other oligomers. According to Table 1, oligomers 1B, 1C, and 1D have the same amount of HSR. With an increase in SSR, the viscosity of the formulations decreased.

Table 2 lists the physical properties of the cured formulations. Heat distortion temperature (HDT) is important for operating temperature of the printed objects, especially for non-prototype applications. Oligomers 1C and 1D gave the highest HDT. Both of them had high HSR and the highest acrylate amount (AR), while oligomer 1D had higher SSR, which resulted in a slightly higher elongation at break and a lower tensile modulus compared to 1C. It was interesting that the HDT of 1D was same as 1C even though it had higher SSR. From 1B to 1C, AR and SSR were increased by about the same factor, as a result the HDT increased (despite the increase in SSR). 1A provided very good elongation due to its high SSR. It can be used as an additive oligomer in objects that require relatively high elongation rates.
Oligomers with Type 3 structure have an average of three acrylate functionalities per polymer chain. It does not seem like increasing functionality of an oligomer simply improves HDT. When compared to 1B, 3A has the same HSR and also has relatively higher SSR and lower AR, which as expected, result in lower HDT than 1B. Higher functionality of 3A did not improve HDT. Oligomers 3B and 3C have significantly higher HSR and lower SSR than 3A, which resulted into higher HDT. It is interesting to note that 3A has practically the same T\(_{g}\) as 3B and 3C, but it has significantly lower HDT. This is most likely due to higher amount of trapped soft segments that are relatively easier to deform at elevated temperatures.

The cure speed of a formulation is an important factor in many 3D printing applications. Relative cure speeds of the formulations were measured by photo-DSC, based on time to reach gel point. Formulations with Type 2 oligomers cured relatively slowly. Type 1 oligomers cured relatively fast except very high SSR ratio oligomer (1A). Among Type 3 oligomers, 3B cured fastest possibly due to a lower SSR ratio.

**Conclusion**

In this paper, we have described several, new polyurethane acrylate oligomers of differing structure which may find uses in a wide range of 3D printing applications. These oligomers’ physical properties have been compared in a model formula and various structure-property relations have been explored. Several oligomers exhibited high heat distortion temperatures and fast cure speeds. Such oligomers could be useful in applications where the material properties need to more closely resemble common plastics like PC or ABS. Still other oligomers may have value in different 3D printing applications requiring a material with a balance of hardness, toughness, and flexibility. Understanding the relationship between the structure of these oligomers and their ultimate properties can lead the way to tailor-made products for each 3D printing application.
HSE update

REGACH/CLP

Guidance on substances in articles updated

Following the judgement of the Court of Justice in September 2015, ECHA has now updated its guidance on requirements for substances in articles. This quick update corrects the parts of the guidance with references to the 0.1% limit that are no longer consistent with the conclusions of the court’s judgement. A more comprehensive update of the guidance will follow in 2016. It is foreseen to include a general update and re-structuring of the document, new examples that are aligned with the court’s judgement and a review of the current examples against the experience gained and questions received by ECHA since the guidance was first published. This update will be subject to the normal three-step guidance consultation process, which will include a consultation with ECHA’s accredited stakeholders. RadTech Europe is reviewing the updated guidance and will be closely involved in the consultation process. The updated guidance can be found here.

REACH data-sharing principles clarified

A new implementing regulation adopted by the European Commission defines more clearly what the terms ‘fair, transparent and non-discriminatory’ mean for data sharing in the REACH Regulation. Amongst others, potential registrants are given the right to gain more insight in the breakdown of costs for a joint registration. It also gives ECHA the mandate to make sure that all registrants of the same substance are part of one joint registration. The regulation is applicable as of 26 January 2016. More information on the new rules can be found here.

Update to the list of substances potentially subject to compliance checks

ECHA has updated the list of substances that might be chosen for compliance checks with 72 new substances. Registrants are advised to check this list and if needed, update their related registration dossiers by 11 April 2016.

LIST OF SUBSTANCES

ECHA shortlists substances for possible regulatory action

Nearly 300 substances have been selected from REACH registrations for further scrutiny by the Member State competent authorities. The competent authorities will carry out a manual examination of the dossiers they prioritize to decide whether there is a need for regulatory action.

NEWS ALERT

ECHA launches extensive information cards on 120,000 substances

ECHA has launched an online guide to offer information about the hazard profiles of thousands of chemicals. Based on information from the EU REACH regulation, the tool gives a summary of key information on chemical substances in layman terms. The database can be accessed here.

Consultation for HDDA as substance of very high concern

Following the proposal of Sweden, the Member State Committee is reviewing data to assess whether hexamethylene diacrylate (HDDA) could be identified as a substance of very high concern based on its skin sensitizing properties. In response, the PARAD consortium, CEPE and CEFIC have submitted responses to show the risk management measures in place and convey the opinion of the industry.

Switzerland notifies European Commission concerning draft ordinance on foodstuffs

Switzerland notified the European Commission (EC) a draft Ordinance on foodstuffs and commodities (notification 2015/9505(CH)) on October 5, 2015, and a draft Ordinance on materials and articles intended for contact with foodstuffs (notification 2015/9507(CH)) on October 12, 2015.

CEFI GMP guidance

The CEFIC UV/EB Acrylates group has released guidance on good manufacturing practices for the production of UV/EB resins for coatings and inks intended for use on the non-food-contact surfaces of food packaging. This document was developed to reflect the strong commitment of the European UVEB resin industry to comply with food contact and consumer safety requirements. While use of the guide is voluntary, it is strongly recommended. The document, covering topics such as Quality Management systems and documentation, personnel and training, raw material controls, production, packaging and quality control, can be found using the following link: http://www.cefic.org/Documents/Industry%20sectors/UV/UEVB.pdf

EuPIA Sponsors Round Robin Acrylate Monomer Analysis Exercise

A round robin acrylate analysis exercise has recently been completed by thirteen members of EuPIA, as well as six third party migration test houses and three printers/convertors from across Europe. This was managed by the Deutsches Referenzbüro für Lebensmittel-Ringsversuche & Referenzmaterialien (DRRR), the German reference office for food proficiency testing and reference materials, a service company for external quality assurance of laboratories involved in the food economy.

The exercise was established to allow member companies of EuPIA’s Energy Curing Work Group (ECWG) and other interested parties to gauge their level of competency for analysing low levels of acrylate monomers, compared to others operating in the same technical area. Participation for the members of the ECWG was kindly financed by EuPIA.

Each participant in the round robin exercise was provided with two model...
solutions of five acrylate monomers recognised to be essential to the formulation of low migration UV and EB inks and varnishes. The levels of the monomers in each solution was set to be in the region of levels that would be anticipated to be found during migration studies for food packaging printed with low migration energy curing products. The outcome of the exercise was that all of the participants were judged to be competent to analyse the five acrylate monomers over the two concentration ranges used.

**Updated EuPIA guideline for printers on the safe use of energy curing printing inks and varnishes**


**ROHS**

An application for extension of the exemption for mercury under the RoHS has been submitted by the LightingEurope working group with data and partial funding by RadTech Europe. Two additional requests for extension of the exemption have been submitted, by VDMA and VSKE. EuPIA has submitted a letter in support of the LightingEurope submission. In October 2015, the consultation period for these applications closed. As a next step, the Oeko Institut will provide a recommendation for the European Commission, followed by a decision of the European Commission early this year.

**Patents**

**EBC-CROSSLINKED ADHESIVE TAPE FOR SHEATHING ELONGATED GOODS**

Inventor(s): GÜNZLER FABIAN [DE]; SIEBERT MICHAEL [DE]; SEITZER EBC; HÖLGER CHRISTOF [DE] + Applicant(s): TESA SE [DE] + Application number: US201514882806 20151014

Method for wrapping cables which are exposed to elevated temperatures and/or humidity, with an adhesive tape comprising a carrier and a pressure-sensitive adhesive composition which is applied to at least one side of the carrier and is in the form of a dried and electron beam (EBC)-crosslinked polymeric acrylate dispersion which is built up from a) monomeric acrylates and optionally b) ethylenically unsaturated comonomers which are not acrylates, wherein the pressure-sensitive adhesive composition comprises between 15 and 100 parts by weight of a tackifier (based on the weight of the dried polymeric dispersion).

**RADIATION-CURABLE INKJET INKS AND COATINGS**


The present invention provides radiation-curable (UV-curable) inks and coatings for inkjet printing comprising an inert thermoplastic acrylic resin and multifunctional monomers. The inks and coatings can be applied in a single pass printing operation. Furthermore, the inks and coatings are suitable for the printing of food, pharmaceutical and other sensitive packaging materials, particularly of plastic materials. The acrylic polymer (or copolymer) preferably has a molecular weight of 10,000 g/mole, or less, and the ink comprises less than 5 wt% of any blend of multifunctional monomer. The inks and coatings of the invention are particularly suitable for curing by UV-LED radiation.

**MODULAR UV LED LAMP REFLECTOR ASSEMBLY**


A reflector assembly may comprise a frame assembly comprising a first backing frame having a first curvature and a second backing frame having a second curvature opposing the first curvature. The reflector assembly may further comprise a first reflector sheet of a material. The first reflector sheet may be removably secured to the first backing frame. The first backing frame may flex the first reflector sheet to have the first curvature. The reflector assembly further comprises a second reflector sheet of a material. The first reflector assembly may further comprise a first reflector sheet of a material. The first reflector sheet may be removably secured to the first backing frame. The first backing frame may flex the first reflector sheet to have the first curvature.
PHOTOCURABLE COMPOSITION AND OPTICAL ELEMENT ADHESIVE INCLUDING SAME


Provided is a photocurable composition whereby a wet-spreading range and discharge amount can be favorably controlled using a discharge device or the like, excellent curing properties are obtained by UV-LED irradiation, and a cured product having excellent solder reflow heat resistance can be formed. This photocurable composition includes a component (A), a component (B), a component (C), and a component (D). Component (A): an epoxy compound having an allylic epoxy group and not having an ester bond; component (B): an oxetane compound; component (C): a photocationic polymerization initiator having an anion including phosphorus to which a fluorinated alkyl group is bonded, or an anion including boron; component (D): an inorganic filler.

UV-CURING LIGHT-BLOCKING COMPOSITION

Application number: KR20157026238 20140225

The purpose of the present invention is to provide a UV-curing light-blocking composition capable of forming a UV-curing light-blocking article that is adequately cured as a thick film. The present invention is a UV-curing light-blocking composition containing a UV-curing compound, and glass filler that contains nickel oxide and cobalt oxide.

ELECTRON BEAM CURABLE RESIN COMPOSITION, REFLECTOR RESIN FRAME, REFLECTOR, SEMICONDUCTOR LIGHT-EMITTING DEVICE, AND MOLDED ARTICLE PRODUCTION METHOD


Provided are an electron beam curable resin composition including an olefin resin, and a crosslinking agent, in which the crosslinking agent has a saturated or unsaturated ring structure, at least one atom among atoms forming at least one ring is bonded to any allylic substituent of an allyl group, a methallyl group, an allyl group through a linking group, and a methallyl group through a linking group, and the crosslinking agent is blended in an amount of more than 13 parts by mass and 40 parts by mass or less with respect to 100 parts by mass of olefin resin, a reflector resin frame using the resin composition, a reflector, a semiconductor light-emitting device, and a molding method using the resin composition.

UV CURING PROCESS TO IMPROVE MECHANICAL STRENGTH AND THROUGHPUT ON LOW-K DIELECTRIC FILMS


A low k porous dielectric film with improved mechanical strength and methods for making the same are disclosed herein. A method of forming a dielectric layer can include positioning a substrate in a processing chamber, delivering a deposition gas to the processing chamber, depositing a dense organosilicon layer using the deposition gas on the substrate, the dense organosilicon layer comprising a porogenic carbon, forming a pore-forming plasma from a reactant gas, exposing the dense organosilicon layer to the pore-forming plasma to create a porous organosilicon layer, wherein the pore-forming plasma removes at least a portion of the porogenic carbon and exposing the porous organosilicon layer to ultraviolet (UV) radiation.

UV Gel Curing Apparatus and LED Light Tube for Use in the Same


The UV nail gel curing apparatus includes a UV light tube and a body having a UV light tube receptacle. The UV light tube may be an UV light bulb or a UV LED light tube. The UV LED light tube includes a housing, a circuit board and pins fixed to the circuit board. The pins can be electrically connected to the gel curing apparatus. The circuit board includes a part hole to receive a large part such as a capacitor or a condenser. Furthermore, heat dissipation holes are formed on the circuit board right next to each of the LEDs for dissipating heat generated by the LEDs.

LED-UV curing machine used in coating or painting operation


Disclosed herein is an LED-UV curing machine for curing a coated or painted solution, which includes a main body installed on a conveyor, a heat treatment portion on a upper surface of the main body, an LED-UV light source and at least one heat radiator, wherein after the solution (a volatile solvent + solute ) used to coat or paint is applied onto the surface of the product, the volatile solvent is evaporated by passing through the heat treatment portion, and the solute is reacted with UV light in a curing portion and cured, heat generated from the LED-UV light source is dispersed through the heat radiator and is expelled to an outside so that a life of the LED-UV curing machine is prolonged, a small amount of heat released through a lens of the LED-UV curing machine is delivered onto the surface of the product so as to improve a efficiency of curing of the solution, and the volatile solvent is capable of reacting with a small amount of heat released through the lens due to a property of the solution.

ELECTRON BEAM CURABLE RESIN COMPOSITION, REFLECTOR RESIN FRAME, REFLECTOR, SEMICONDUCTOR LIGHT-EMITTING DEVICE, AND MOLDED ARTICLE PRODUCTION METHOD


Provided are an electron beam curable resin composition including an olefin resin, a crosslinking agent, and a white pigment, in which the crosslinking agent has a saturated or unsaturated ring structure, at least one atom among atoms forming at least one ring is bonded to any allylic substituent of an allyl group, a methallyl group, an allyl group through a linking group, and the crosslinking agent has a saturated or unsaturated ring substituent of an allyl group, a methallyl group, an allyl group through a linking group, and a methallyl group through a linking group, and the crosslinking agent is blended in an amount of more than 13 parts by mass and 40 parts by mass or less with respect to 100 parts by mass of olefin resin, a reflector resin frame using the resin composition, a reflector, a semiconductor light-emitting device, and a molding method using the resin composition.
A photocurable acrylate composition, containing a compound of formula (I) as a photoinitiator and the components adapted to the photoinitiator. The photocurable composition has very good storage stability and very high light sensitivity, can be cross-linked and cured at a very low exposure dose, and has a very good curing effect; a film made from the composition has a smooth edge, no defect and scum, and good integrity throughout the whole pattern, and is a high-hardness resist film, and an optical filter made therefrom has high optical transparency and no light leakage.

Methods for making a low k porous dielectric film with improved mechanical strength are disclosed herein. A method of forming a dielectric layer can include delivering a deposition gas to a substrate in a processing chamber, the deposition gas comprising an acrylate precursor with a UV active side group and an oxygen containing precursor; activating the deposition gas to deposit an uncured carbon-containing layer on a surface of the substrate; and delivering UV radiation to the uncured carbon-containing layer to create a cured carbon-containing layer, the UV active side group crosslinking with a second group.

In the invention, there is no risk that the physical properties of the cureable material are deteriorated. The (meth)acrylate has one or more structures represented by Formula 1 in the molecule, and when the (meth)acrylate is used for radical curing, the sensitivity is enhanced. In Formula 1, R1 is a hydrogen atom or a methyl group, R2 is a C1-C10 alkyl chain, R3 is either Formula 2 or 3, and R4 is an alkyl chain constituted by carbon atoms and hydrogen atoms.

An inkjet printing method including the steps of: (1) jetting ink dots on a substrate of a plurality of radiation curable inkjet inks having a viscosity of no more than 50 mPa.s at 25 DEG C and a shear rate of 90 s-1, the plurality of radiation curable inkjet inks comprising: a) at least one non-polymerizable, non-polymeric bisacryolphosphate oxide present in a concentration of no more than 4.0 wt% based on the total weight of radiation curable inkjet ink; b) at least one monomer comprising at least one vinyl ether group and at least one polymerizable group selected from the group consisting of an acrylate group and a methacrylate group; and c) at least one polymerizable or polymeric thiooxanthone, with the proviso that if the at least one polymerizable or polymeric thiooxanthone contains no tertiary amine group that the radiation curable composition further includes at least one tertiary amine co-initiator selected from the group consisting of ethylhexyl-4-dimethylaminobenzoate, a polymerizable co-initiator containing a tertiary amine and a polymeric co-initiator containing a tertiary amine; and (2) fully curing the jetted ink dots using one or more UV LEDs.

Provided is a (meth)acrylate and a radical curable material with which the sensitivity can be enhanced to improve the curability, the increase in viscosity can be suppressed due to good compatibility with various acrylate compounds, and there is no risk that the physical properties of the curable material are deteriorated. A photocurable material having a viscosity of no more than 50 mPa.s at 25 DEG C and a shear rate of 90 s-1, the plurality of radiation curable inkjet inks having a viscosity of no more than 50 mPa.s at 25 DEG C and a shear rate of 90 s-1, the plurality of radiation curable inkjet inks comprising: a) at least one non-polymerizable, non-polymeric bisacryolphosphate oxide present in a concentration of no more than 4.0 wt% based on the total weight of radiation curable inkjet ink; b) at least one monomer comprising at least one vinyl ether group and at least one polymerizable group selected from the group consisting of an acrylate group and a methacrylate group; and c) at least one polymerizable or polymeric thiooxanthone, with the proviso that if the at least one polymerizable or polymeric thiooxanthone contains no tertiary amine group that the radiation curable composition further includes at least one tertiary amine co-initiator selected from the group consisting of ethylhexyl-4-dimethylaminobenzoate, a polymerizable co-initiator containing a tertiary amine and a polymeric co-initiator containing a tertiary amine; and (2) fully curing the jetted ink dots using one or more UV LEDs.

A photocurable material that allows dark portion curing even if the form of a material to be cured is complicated and the length of an unirradiated portion is long. The photocurable material has both of radical curability and anionic curability, is a photocurable liquid composition curable by irradiation of light, and contains (meth)acrylate and a chain transfer agent, wherein the chain transfer agent is a compound containing one or more of at least one kind selected from a urethane bond, a urea bond, and an isocyanate group, and one or more alkoxyisilyl groups. The photocurable material is capable of curing even a portion that irradiation light does not reach.

In the process of producing optical member, and ultraviolet-curable resin composition for use in same, a photocurable material having a viscosity of no more than 50 mPa.s at 25 DEG C and a shear rate of 90 s-1, the plurality of radiation curable inkjet inks having a viscosity of no more than 50 mPa.s at 25 DEG C and a shear rate of 90 s-1, the plurality of radiation curable inkjet inks comprising: a) at least one non-polymerizable, non-polymeric bisacryolphosphate oxide present in a concentration of no more than 4.0 wt% based on the total weight of radiation curable inkjet ink; b) at least one monomer comprising at least one vinyl ether group and at least one polymerizable group selected from the group consisting of an acrylate group and a methacrylate group; and c) at least one polymerizable or polymeric thiooxanthone, with the proviso that if the at least one polymerizable or polymeric thiooxanthone contains no tertiary amine group that the radiation curable composition further includes at least one tertiary amine co-initiator selected from the group consisting of ethylhexyl-4-dimethylaminobenzoate, a polymerizable co-initiator containing a tertiary amine and a polymeric co-initiator containing a tertiary amine; and (2) fully curing the jetted ink dots using one or more UV LEDs.
A process for producing an optical member which includes at least two optical substrates laminated to each other, the process comprising the following steps 1 to 3 and using a resin composition in which the 25 DEG C storage modulus of a resin layer irradiated with ultraviolet rays in the following step 3 is 1.5-10 times that of the resin layer irradiated with ultraviolet rays in the following step 1 and which, after irradiated with ultraviolet rays in the following step 1, has a 25 DEG C storage modulus of 1102-1104 Pa: [step 1] a step in which an ultraviolet-curable resin composition comprising a (meth)acrylate (A) and a photopolymerization initiator (B) is applied to at least one optical substrate to form a coating layer and the coating layer is irradiated with ultraviolet rays, thereby obtaining an optical substrate having a cured object layer comprising a cured portion of the coating layer which is present on the reverse side from the optical-substrate side; (step 2) a step in which the uncured portion of the optical substrate obtained in step 1 is laminated to another optical substrate or to the uncured portion of another optical substrate obtained in step 1; and [step 3] a step in which the uncured-portion-containing cured object layer of the optical substrate laminated in step 2 is irradiated with ultraviolet rays through the other optical substrate, thereby curing the cured object layer.

**LED CURING OF RADIATION CURABLE OPTICAL FIBER COATING COMPOSITION**

Inventor(s): TIMOTHY BISHOP; CAN KEOI +
Applicant(s): DSM IP ASSETS BV +
Application number: JP20150124887 20150622

PROBLEM TO BE SOLVED: To provide a radiation curable coating composition for an optical fiber, and a method for compounding the composition.

SOLUTION: The radiation curable coating composition for an optical fiber is provided which can undergo photopolymerization when coated on an optical fiber and when irradiated with light emitting diode (LED) light having a wavelength from about 100 nm to about 900 nm, to thereby provide a cured coating on the optical fiber, with the cured coating having a top surface, and the cured coating having a Percent Reacted Acrylate Unsaturation (%RAU) at the top surface of about 60% or greater.

**LED-UV offset printing ink and preparation method therefor and use thereof**

Inventor(s): WANG XUN +
Applicant(s): BEIJING JINHONGYING TECHNOLOGY CO LTD +
Application number: CN20141186472 20140505

The invention provides LED-UV offset printing ink and a preparation method therefor and use thereof. The LED-UV offset printing ink comprises a connecting material, a reaction monomer, a light sensor, a polymerization inhibitor, a colorant and a diluent, wherein the reaction monomer comprises a medium viscosity reaction monomer and a low viscosity reaction monomer. The LED-UV offset printing ink comprises the components in percentage by weight: 45-60% of the connecting material, 9-19% of the medium viscosity reaction monomer, 1-10% of the low viscosity reaction monomer, 1-12% of the light sensor, 0.01% of the polymerization inhibitor, 10-15% of the colorant and 1-15% of the diluent, totally 100%. The LED-UV offset printing ink provided by the invention is environmental-friendly and energy-saving, so that the LED-UV offset printing ink is suitable for food package and package of other decorations, and the using safety of the LED-UV offset printing ink is improved.

**3D-INKJET PRINTING METHODS**

Inventor(s): VANMAELE LUC [BE]; DAEMS EDDIE [BE]; DE VOEGHT FRANK [BE]; THILLO ETIENNE VAN [BE] +
Applicant(s): AGFA GRAPHICS NV [BE] +
Application number: IN2009CHENP3549 20090619

Abstract A 3D-inkjet printing method comprising the steps of: a) providing two or more fluids having a different composition to an inkjet printer; b) mixing the or more fluids in a controlled amount; and c) jetting the mixture of the two or more fluids with the Inkjet printer onto a support; d) at least partially curing the jetted mixture by actinic radiation or electron beam; and e) repeating steps b) to d) in order to build a 3-D relief on the support. Printed 3D-objects, Inkjet fluid sets and Inkjet printers are also disclosed.

**SYSTEMS, METHODS AND DEVICES FOR STRENGTHENING FLUID SYSTEM COMPONENTS USING RADIATION-CURABLE COMPOSITES**

Inventor(s): LAZZARA CHRISTOPHER J [US]; BICERANO JOZEF [US] +
Applicant(s): NEPTUNE RES INC [US] +
Application number: US201514753423 20150629

Methods are provided for strengthening (e.g., reinforcing, structurally reinforcing, etc.) a fluid-system component by installing, as a circumferential wrap or a patch, a radiation-curable composite laminate. Kits including composite repair materials and equipment for implementing the methods are also provided. Examples of fluid-system components that may be strengthened include pipework, pipelines, transmission pipelines, distribution pipelines, gathering lines, oil risers, gas risers, process piping, girth welds on pipelines or vessels, tanks, vessels, elbows, tees, flanges, and high-pressure injection lines. An approach where, prior to curing, the precursor to the composite laminate comprises a glass fabric, a carbon fabric, or any combination(s) thereof, pre-impregnated with an uncured epoxy resin, an uncured epoxy acrylate resin, or a mixture thereof, is used; curing is performed via electron beam irradiation; and the installation and curing procedures can be automated to the maximum extent possible, in exemplary embodiments of the present disclosure.

Active energy ray-curable resin composition and cured article thereof

Inventor(s): MAKITA SHOHEI; FUNAKOSHI CHIHIRO; MINEGISHI SHOJI +
Applicant(s): AIYOR INK MFG CO LTD +
Application number: CN2014803595 20140227

The present invention provides an active energy ray-curable resin composition that...
exhibits high close-adhesiveness and excellent wear resistance even under high temperature and high humidity without virtually any warping when cured by ultraviolet rays, electron beam, or other active energy ray, and that has secondary processability such as excellent molder after curing. This active energy ray-curable composition is characterized by containing: a urethane resin having a plurality of acrylate groups or methacrylate groups; at least one amide or amide derivative selected from those having an ethylenic double bond; at least one bifunctional acrylate or bifunctional methacrylate selected from those having a cyclic skeleton containing no carbon-carbon double bond; a photopolymerization initiator; and a polymer containing no ethylenic double bond. This active energy ray-curable composition is characterized if furthermore characterized in that the polymer containing no ethylenic double bond dissolves in at least one amide or amide derivative selected from those having an ethylenic double bond.

**Crosslinkable resin composition, cured product and method for producing same**

**Device for manufacturing of three-dimensional objects**

**UV CURABLE SOLVENTLESS ANTIMICROBIAL COMPOSITIONS.**

**DEVICE FOR MANUFACTURING OF THREE-DIMENSIONAL OBJECTS**

**MONOCROMATIC ACTINIC RADIATION CURABLE COATINGS FOR OPTICAL FIBER**

**ORGANOSILICON MODIFIED PHOTOINITIATOR AND PHOTO-CURABLE ADHESIVE COMPOSITION THEREOF**
An organosilicon modified photoinitiator represented by the general formula (I) and a photo-curable adhesive composition thereof are provided.

RADIATION CURABLE POLYTHIOETHERS WITH ALKYNE-BASED LINKAGE

Certain polythioether polymers are presented, as well as compositions which are radiation curable to polythioether polymers and seals and sealants comprising same. The compositions radiation curable to polythioether polymers include those comprising: a) at least one thiol monomer; b) at least one diene monomer; c) at least one polyene monomer comprising at least two ethyne groups; and d) at least one photoinitiator. In some embodiments, the polyethylene monomer is a diyne monomer. In some embodiments, the composition also comprises at least one epoxy resin. In another aspect, the compositions radiation curable to polythioether polymers include those comprising: i) at least one thiol terminated polythiobor polymer; g) at least one diyne monomer; and h) at least one photoinitiator. In some embodiments the thiol terminated polythioether polymer comprises pendent hydroxide groups.

PHOTOSENSITIVE COMPOSITION CONTAINING OXIME-ESTER PHOTOSTARTER AND APPLICATION THEREOF
Inventor(s): QIAN XIAOCHUN [CN] + CHANGZHOU TRONLY NEW ELECTRONIC MATERIALS CO LTD [CN]; Applicant(s): CHANGZ PIONEER ELECTRONIC MATERIALS CO LTD [CN] + CHANGZ PIONEER NEW ELECTRONIC MATERIALS CO LTD [CN]; Application number: WO2015CN77081 20150421

Provided is a photosensitive composition containing an oxime-ester photoinitiator. The oxime-ester photoinitiator is a compound as shown in formula (I). The composition has the advantages of high curing speed, small exposure dose, less pollution, energy saving, almost no residue defect, etc., and the thickness, clarity and pattern integrity of a cured film thereof are all excellent.

UV-CURABLE COATING COMPOSITION
Inventor(s): KOSTROMINE SERGUEI [DE]; KÜHN FRAUKE [DE]; Applicant(s): BAYER MATERIALSCIENCE AG [DE] + Application number: US201414763549 20140130

The present invention relates to a coating composition comprising: a) one or more alkylphatic polymer precursors selected from the components A.1 and optionally A.2; a) aliphatic oligomers containing urethane or ester bonds and having at least two acrylate functions per molecule, or mixtures of said oligomers, and A.2) aliphatic reactive diluents having at least two acrylate groups per molecule, or mixtures of said reactive diluents, b) optionally one or more finely divided inorganic compounds, c) an organic UV absorber, d) optionally a free radical scavenger from the HALS class, e) optionally one or more levelling additives, f) optionally one or more solvents, and g) a photoinitiator. It further relates to a process for the coating of a substrate, to the coated substrates obtainable in this way, and to the use of the coated substrates.

(4-PHENYL BENZOYL) BENZOATE AND USE THEREOF AS PHOTOSTARTER
Inventor(s): ZHAO WENCHAO [CN]; LI JING [CN]; LI JIAQI [CN]; SHAO JUNFENG [CN]; YAO LIUXI [CN] + Applicant(s): INSIGHT HIGH TECHNOLOGY CO LTD [CN] + Application number: WO2015CN77081 20150421

Provided are a compound represented by formula (I), a method of synthesizing same and a use thereof as photoinitiator. In the formula, each A represents an oxygen atom or independently represents a group of formula (AA), (BB) or (CC); G represents a residue of a polyol, and 2 <= n <= 6; x1 is a positive integer, 2 <= x2 <= n and x2 is n-x; and R represents a hydrogen atom, a C1-C12 alkyl acyl, an acyl acyl or a C2-C4 conjugated alkenyloxy.

POLYMERIC PHOTOSTARTERS
Inventor(s): NIELSEN CHRISTIAN [DK]; MADSEN NIELS B [DK]; JOERGENSEN CHRISTINA MAJ [DK] + Applicant(s): COLOPLAST AS [DK] + Application number: US201514854053 20150915

A polyalkylether photoinitiator of the general formula I, R1(A1)n-I-(R2(A2)m-O)n-(R3(A3)n-O)n-(R4(A4)s-I, wherein R1, R2, R3, R4 and m, n, o, p, r and s are as defined herein and A1, A2, A3 and A4 are identical or different photoinitiator moieties.

PHOTOCURABLE COATING, LAMINATE AND SHEET FOR COATING AUTOMOBILE HEAD LAMP
Inventor(s): MASUDA KOHEI; HICUCHI KOICHI; YOSHIKAWA YUII + Applicant(s): SHINETSU CHEMICAL CO + Application number: JP20140207984 20141009

The invention describes the use of a water-based UV curable ink jet printing ink wherein the ink is basic due to the presence of a tertiary amine, allowing the complete dissolution of an acid functional photoinitiator of Formula I or Formula IA (wherein R1, R2, R3, n, q and y are as defined herein). This combination of photoinitiator and tertiary amine allows the rapid low dosage UV curing of a water-based UV formulation using a UV LED light source.

PROBLEM TO BE SOLVED: To provide a photocurable coating to which titanium oxide fine particle is incorporated and excellent in transparency and long ultraviolet shielding performance, a laminate having a coated film of the coating, and a sheet for coating an automobile head lamp using the laminate.

SOLUTION: There is provided a photocurable coating containing (1) surface treated titanium oxide obtained by treating a core-shell type fine particle having titanium oxide which may composite an inorganic oxide (excluding titanium oxide) as a core and a shell of silicon oxide outside of the core with both surface treatment components represented by the formula (I) and the formula (II), (2) photopolymerizable monomer and/or oligomer and (3) a photoinitiator. RSi(OR)
RadTech has participated in the largest Paint Congress in Latin America in the last quarter of 2015. The ABRAFATI 2015 Paint Congress held in São Paulo took place last October and for 3 days RadTech South America made its own congress with great success. Many people participated in the lectures and discussed the last news and technologies involving radiation cure systems and their applications with the most important suppliers of the world. Our partnership with ABRAFATI is working well, and it is getting stronger every year. We hope to have more events with them soon.

Recognition by SITIVESP

RadTech South America has been recognized as an important association in the market by SITIVESP (Syndicate of the Paint Industries of São Paulo State) for our work in promoting this technology and helping companies to develop the radiation cure system in their applications and products. As a result of this, we are improving our relationship with this important syndicate to promote our technology in the industry even more.

Technical Forums

RadTech South America has been participating in several technical forums held by an important magazine of the Paint Industry in Brazil called Pain&Pintura. The last event took place in Belo Horizonte in Minas Gerais state with more than 50 people participating in several technical forums held by an important magazine.

Events

We have defined an agenda of RadTech South America events and seminars for 2016 including seminars about UV LED technology, Radiation Cure systems for Plastics, Food and Wood, as well as Energetic Efficiency and Sustainability besides our regular basic seminars for Radiation Cure technology that we hold every year. We plan to hold all these events during the year and keep promoting this technology through various applications. Our next seminar is the Basic Radiation Cure Technology and will take place in the end of March 2016.

RadTech South America Latest News

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News from the Industry

COMPANY NEWS
IST METZ repositions itself

December 2015- IST METZ GmbH is taking the growing business with LED UV systems into account. In May, the company has already acquired the majority interest in Integration Technology Ltd. The reorganisation of the management board followed recently.

The UV market is changing: Besides the classic UV medium pressure lamps, in recent years the curing of inks and varnishes by means of UV LEDs has been established. This has even opened up whole new business areas, e.g. in the industrial joining technology. Offering both types of UV systems, IST METZ GmbH has even further expanded the LED business this year. Apart from the successful market launch of its own high-performance LED products, the acquisition of the majority interest in the British UV systems manufacturer Integration Technology Ltd. in May brought an additional gain in expertise in this field.

Because of the greater focus on technological development, the management board of IST METZ GmbH has also been reorganised recently. Christian-Marius Metz, grandson of deceased company founder Gerhard Metz and previous Head of the Central Area Operations & Services, was appointed Chief Executive Officer. Holger Kühn was made Managing Director Sales. He has been part of the company for 17 years in various functions in sales, most recently as Head of the Central Area Sales. Dr. Robert Sänger will complete the management board from the beginning of next year as Managing Director Technology. Having been Head of Development at the subsidiary eta plus electronic GmbH, he will now join the parent company. Dirk Jägers, previous Managing Director of IST METZ GmbH, left the company.

MARKET INFORMATION
RevolutionAIR, The new MBS®

October 2015 - At Labelexpo Europe, the world’s most important trade fair for label printing, which is taking place from 29th September till 02nd October in Brussels, UV systems manufacturer IST METZ will be showing the latest trends in UV label printing at stand 5D31. According to the Yole market research institute, LED technology is expected to achieve a market share of around 30 per cent in 2016, a significant rise compared to previous years. LED technology currently makes up the greatest proportion of adhesive curing and inkjet printing. But it is also increasingly requested in label printing. With the new MBS®, IST METZ offers a system in whose housing either UV lamp or LED technology can be used. The MBS® unit can simply be inserted into the machine; all supply connections engage automatically. This enables you to change easily from operation with a UV lamp to UV LEDs. Thanks to the removable internal housing, all components in the unit can be accessed easily and without screws.

For more information: www.ist-uv.com

Formulate 3D Printing Resins with Superior Mechanical Properties & Surface Quality

November 2015 - Dymax Oligomers & Coatings offers Bomar™ oligomers that are ideal for formulating printing inks and resins for SLA, DLP, and 3D inkjet printers. The selection consists of oligomers with varying Tgs that allow for flexibility in mechanical properties. Formulators looking to eliminate object deformation can select an oligomer with a high Tg and low linear shrinkage. The oligomers also cover a large range of viscosities so formulators can achieve the flow characteristics they desire.

In addition to the mechanical properties these oligomers provide, they are non-yellowing for higher optical clarity and offer color stability for better looking objects. Formulations using Bomar™ oligomers also exhibit high impact resistance, making them more durable against dropping and everyday wear. The end product has a tack-free surface and is easy to paint or finish for superior looking products.

World’s first renewable Capa™ for Bioplastics

November 2015 - Perstorp has introduced renewable Capa™ for Bioplastics, the world’s first of its kind. This is a concept which builds on the Capa™ Lactide technology, which enables a high renewable content in combination with vast opportunities to develop products with optimized performance for different bioplastic applications.

There is a strong trend towards sustainability and renewable material in the world. 1 Million plastic bags are used per minute throughout the year. Many of them end up in nature and stay there. By using Perstorp’s renewable Capa™ for Bioplastics those bags will biodegrade.

Perstorp will continue to focus its efforts on three fast-growing bioplastic segments – paper coatings, bags and films, and packaging. It is already well established that Capa™ for Bioplastics is a biopolymer enhancer that offer stability and compatibility, improved mechanical properties, flexibility at low temperatures, and biodegradability. This effort is supported by Perstorp’s full industrial production and pilot facilities in Warrington, U.K. and its modern Swedish innovation center in Perstorp, for bioplastic formulations. With these capabilities we can develop and test concepts and scale up production to an industrial level.

For more information: www.perstorp.com/bioplastics

Miguel Mantas brings to Allnex over three decades of global executive experience in the chemicals and materials industry. A native of Portugal, Miguel Mantas began his professional experience with Hoechst AG in

www.radtech-europe.com
Industry News

These pages feature abstracts of press information received from RTE members or articles concerning RTE members collected from the trade press in recent months. RTE members interested in extra media coverage can send their press releases to the RTE secretariat, e-mail: mail@radtech-europe.com in either word or pdf format (pictures already included in the text). We will then make sure to post them on our website and in the RTE News e-zine (published twice per year).

1986. After a number of promotions to positions of increasing managerial responsibility for various Hoechst business units, he had responsibilities in many regions of the world including Latin America, Asia as well as at the Hoechst corporate center in Germany. In 1998, after the demerger of Hoechst’s industrial activities, Miguel Mantas became Vice President of Sales for Celanese in EMEA. He subsequently managed global business units for Celanese in Engineering Polymers and Chemicals. In 2007, Celanese divested its oxo chemicals business to Adven International and Miguel Mantas became Managing Director of OXEA, the newly formed entity. Under his leadership, OXEA experienced a period of rapid growth and transformation by focusing on specialized oxo derivative segments. After the sale of OXEA to Oman Oil in 2013, Miguel Mantas retained his executive role with the company, which is a wholly owned company of the Government of the Sultanate of Oman. “Miguel is no stranger to Allnex nor the industrial coatings resins space. Over his many decades in the industry, he has been a supplier to many of the coatings and resin companies which we count as our most valued customers. He brings with him not only deep experience in our core business but also a wealth of experience as a global executive with a proven track record of delivering results for all stakeholders. I would also like to express my gratitude to Frank Aranzana for his many contributions to the success of Allnex during his tenure as CEO. Frank will become a member of the Allnex Advisory Committee and an Operating Partner with Adven International, effective as of February 1st”, said Rich Alexander, Chairman of Allnex.

Outlook 2016:

RTE to launch in-depth UV/EB market survey

Following the host of new RadTech Europe initiatives over the past years, such as the PR campaign, the new conference format and the continued success of our long-standing committees and Food Packaging seminars, RadTech Europe will be launching a new tool to provide valuable insights into the UV and EB market as well as specific end-user markets for its members. Acknowledging the urgent need for data within our industry and following on from an initiative of RadTech North America, we will be launching a UV/EB market survey first half of 2016 to our membership. The consolidated results will be available for RadTech Europe members providing input into the survey only, giving real-time access to the trends, opportunities and challenges for the European radiation curing industry. More news to follow in the coming months!

Have your say in the new RTE membership survey

To give us a better understanding of the needs of our members, we are asking you to complete a 10 minute survey. Your input will help us focus on those areas that are most important for you, our member! If you have any questions, please contact us at mail@radtech-europe.com.

Marketing and PR efforts

To further develop our prominent media presence following our PR media campaign, RTE has developed its PR and communication program for 2016. In addition to promoting our own events, the association will also highlight efforts made by other actors in the industry, as well as look at exciting potential new markets for radiation curing.

Changes in the committees

2015 has seen a range of changes in our committees, with some familiar faces saying goodbye, while new faces have come in to follow in their footsteps. We would like to take this moment to thank our long-standing members who have retired this year:

From the Marketing Committee:
• Ian Hutchinson of Sartomer, long-standing member of the RadTech Europe Marketing Committee and one of the driving forces behind the success of our range of food packaging seminars (foto Ian)
• Fred Buckmann of DSM, instrumental in developing our new UV/EB brochure.

From the HSE Committee:
• Elisabeth Blum of BASF
• Ulrich Dreyer of BASF
• Maurizio Colombo of Lamberti
• Fred Zijlmans of IGM Resins B.V.

We would also like to welcome the new additions to our various committees and wish them success in their new roles:

From the HSE Committee:
• Didier Vanhoye of Sartomer, the new chairman of the HSE committee.
• Graham Butterworth of IGM Resins B.V.
• Antoine Carroy of BASF
• Martin Klatt of BASF
• Thomas Casper of RAHN
• Colette Moularet of Allnex
• Perrine Cahen of Allnex

For the Health, Safety and Environment committee:
• Didier Vanhoye of Sartomer, the new chairman of the HSE committee.
• Graham Butterworth of IGM Resins B.V.
• Antoine Carroy of BASF
• Martin Klatt of BASF
• Thomas Casper of RAHN
• Colette Moularet of Allnex
• Perrine Cahen of Allnex

For the Graph Arts working group
• Glen Allbrighton of Sartomer

For the Metal Coating working group
• Xavier Drujon of Sartomer

If you are interested in participating in the work of the association and would like more information on joining one of the committees or working group, do not hesitate to contact the secretariat.

For the Health, Safety and Environment committee:
• Didier Vanhoye of Sartomer, the new chairman of the HSE committee.
• Graham Butterworth of IGM Resins B.V.
• Antoine Carroy of BASF
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• Thomas Casper of RAHN
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Mark your calendar:  
14 October 2016

**Food Packaging seminar in Frankfurt (airport)**

Everything you need to know about using UV and EB for Food Packaging  
- Chemistry  
- Market trends  
- Legislation  
- Developments in equipment  
- Brand-owner outlook  
- End-user case studies

13 October 2016  
General Assembly (and optional dinner)  
14 October 2016: Food Packaging seminar  
Sheraton Frankfurt Airport Hotel

Find out more at  

Confirmed speakers include: PIRA, K&H, Crowne Cork, Sartomer, BASF, EuPIA with more to come!
RadTech News Issue 2, November 2015
RadTech News (e-zine) is published 2 times a year exclusively for members of RadTech Europe. In 2015, the hard copy yearbook will be published after the conference as an overview/report of the 2015 activities for all involved in the UV/EB radiation curing industry.
RadTech Europe is the European Association for the promotion of UV/EB curing technology for inks, coatings and adhesives.

Colophon

Management Committee
President: David Helsby, RadLab/RAHN
Vice-President: Aufrey de Wulff, Allnex
Treasurer: Carolien Bastien, Sartomer Europe
Barbara Fenzi, Lamberti SpA
Nick Gruber, BASF
Nick Ivory, Sun Chemical
Arnd Riekenbrauck, IST METZ GmbH
Dawn Skinner, Heraeus Noblelight Fusion UV Inc.

Chair Marketing Committee: Gregory Gerin, Allnex
Chair HSE Committee: Didier Vanhoye, Sartomer
Chair Metal Coatings Group: Vacancy
Chair EB Project Group: Michael Fischer, Fischer Solutions
Chair Graphic Arts Working Group: Jeroen Diepgrond, BASF

RTE Conference: Dawn Skinner, Heraeus Noblelight Fusion UV Inc.

Association management for RadTech Europe
Mark Macaré, Secretary General
Elke Verbaarschot, Senior Management Assistant
Cora Van der Lek, Financial Support

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RadTech Europe News issue has been compiled with utmost care, RadTech Europe declines any responsibility for possible incompleteness of any information published in this issue.