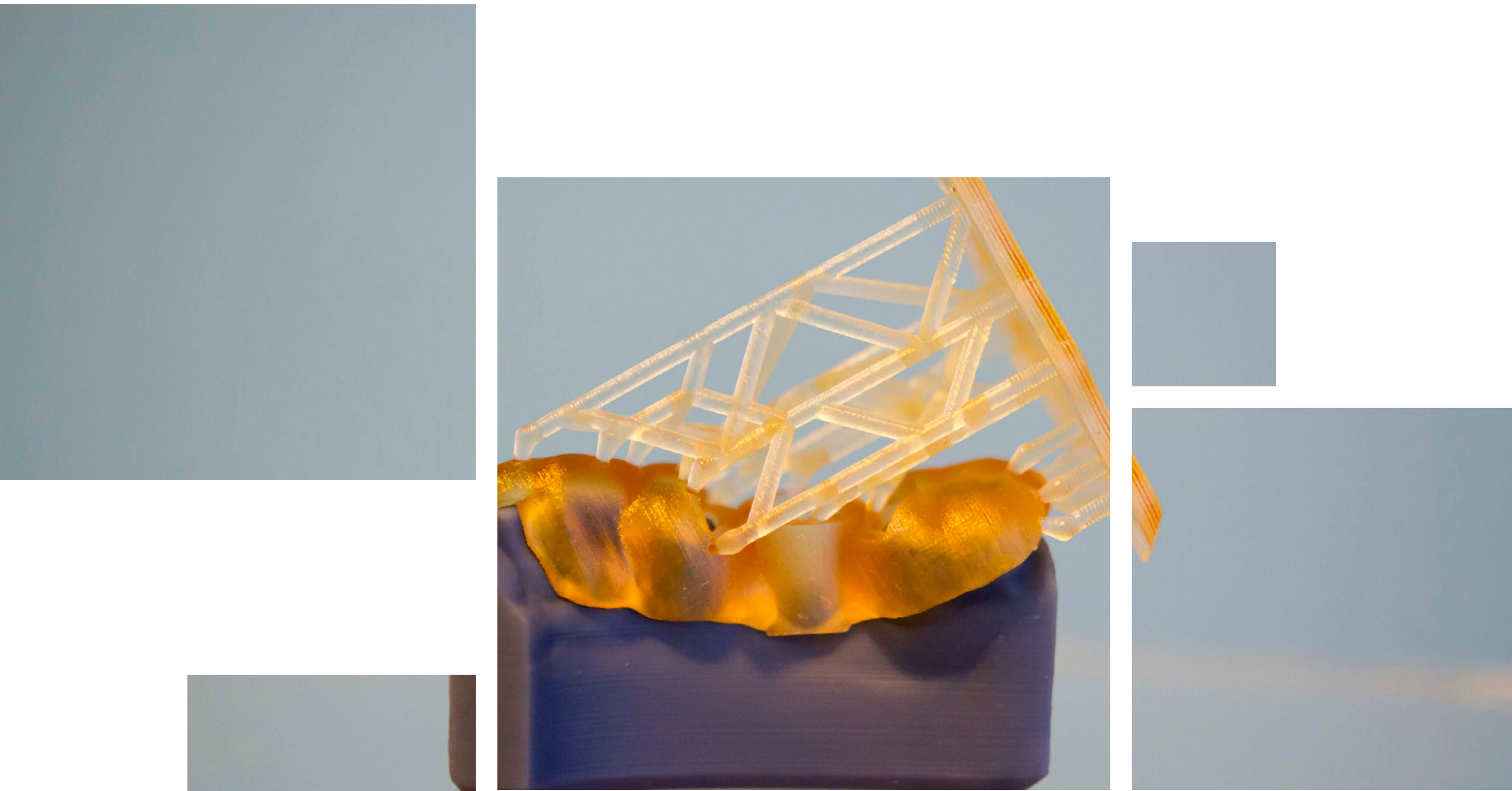


3D Printing

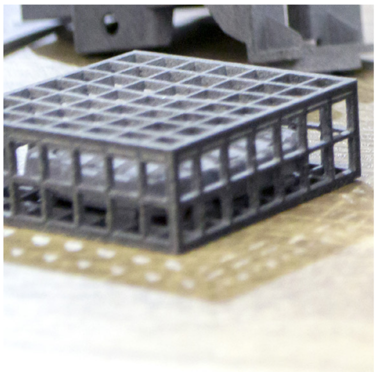
Product guide

We Enable the Transformation of Light for a Better Future

iGM RESINS

3D printing

Product guide



ENERGY CURING RAW MATERIAL AND TECHNICAL SOLUTION PROVIDER

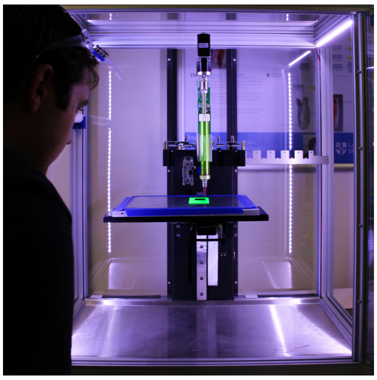
IGM Resins is the leading global provider of energy curable raw material solutions to a wide variety of industries such as graphic arts, industrial coatings, adhesives and 3D printing. The combination of our global presence, unique market driven and customer focused approach, technical and regulatory support, and our comprehensive portfolio of products covering photoinitiators, monomers, oligomers and additives, is the cornerstone of our success.

Our dedication to energy curing technology and the markets we serve is emphasized by the development of next generation products for innovative integrated solutions, and ongoing investment into state-of-the-art manufacturing capabilities.

HOW TO GET MORE FROM US

3D printing is a form of additive manufacturing (AM) where solid, three-dimensional objects are fabricated from a digital model by means of a computer-aided apparatus (3D printer), which precisely controls the deposition/ solidification of material in order to form the object, most commonly in a layer-by-layer fashion.

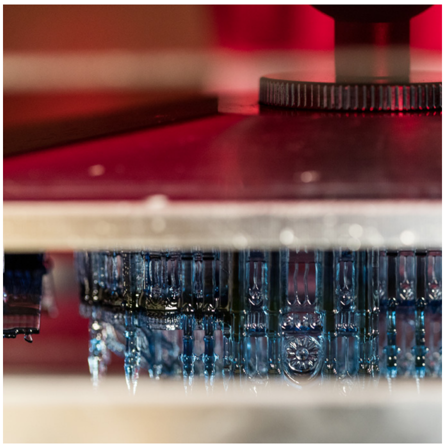
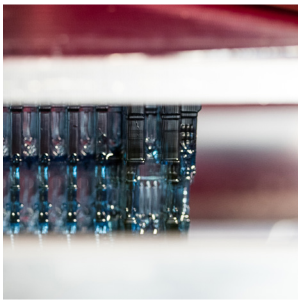
Among many distinct 3D printing technologies, we have those who make use of photopolymers as the



starting material for fabrication, where luminous radiation solidifies light-curable compositions, either selectively (VAT Polymerization techniques) or by controlled deposition of uncured material (Multi-jet and construction techniques).

The development of superior light-curable materials is crucial for the advancement of photopolymer 3D printing, overcoming classic limitations in the mechanical properties of common (meth) acrylate-based formulations and expanding their use outside of just rapid prototyping. This unlocks the full potential of photopolymers in 3D printing in the sense that functional parts can now be fabricated with all the benefits of AM technologies who use these materials, namely their features of superior printing accuracy, surface quality and fabrication speed.

Innovations in photoinitiator technology also allow for the optimization of formulations on multiple aspects: polymeric and high molecular weight initiators have shown to improve printing accuracy and definition in VAT polymerization, besides being safer candidates for use in sensitive applications across the board. Novel photoinitiator chemistries also enable flexibility in formulating solutions for very specific end uses that require the complete absence of inorganic elements in the composition.

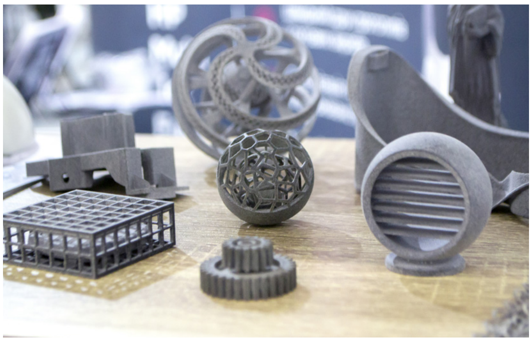
We can separate the use of photopolymers for additive manufacturing in three main categories which will roughly determine basic properties required from the raw materials: Rapid Prototyping, Direct Fabrication and Indirect Fabrication.

THE TECHNOLOGY

3D printing, or Additive Manufacturing (AM), is the fabrication of solid, three-dimensional objects from a digital model. 3D printing is an additive manufacturing process in which object are built up by deposition and fusion of 2-dimensional layers to form a 3-dimensional object.

Rapid prototyping

Rapid Prototyping ranges from simple modelling applications - where mechanical properties and dimensional stability are compromised to a certain extent to favour fast curing rate and competitive cost – to specific prototyping applications which require enhanced resistances and long-term dimensional stability (aka minimal shrinkage).

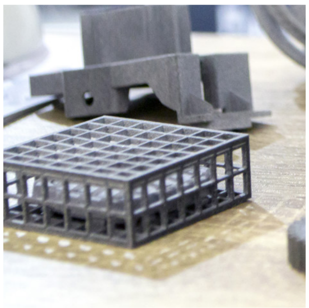


- Fast curing rate
- Competitive cost
- Low shrinkage and viscosity
- Balanced mechanical properties

Direct Fabrication

The direct fabrication of functional parts by means of photopolymer 3D printing requires the most out of the raw materials and compositions. A range of low viscosity oligomers with superior chemical-mechanical properties are key, with suitable diluents to round out other characteristics. The use of additives is helpful in reducing stresses applied to parts during printing and in the incorporation/stabilization of high filler loads.






- High mechanical properties
- Low shrinkage and viscosity
- Wide range of physical/chemical properties
- Low toxicity

Indirect Fabrication

The indirect fabrication of functional parts aided by photopolymer 3D printing require very specific properties from the raw materials. For thermoforming applications, temperature resistance is important while maintaining low shrinkage and adequate mechanical properties. Also prominent in this type of fabrication are the castable compositions, where materials must be free of inorganic compounds in residual form or optimally with no inorganic elements in their chemical structure whatsoever, in order to achieve clean burn-out and also prevent interaction with investment material.

- Low ash content (castable)
- Low shrinkage and viscosity
- Adequate physical/chemical, thermogravimetric, and mechanical properties

To meet these challenging requirements, IGM Resins offers different solutions. In this leaflet you will find information about our product portfolio. Last columns allow you to better select the products. Please note, other products may also show an interest.

Product	Chemistry	CAS Number	UV-Absorption nm	Melting point °C	Degree of yellowing	Rapid prototyping	Direct fabrication	Indirect fabrication

PHOTOINITIATORS

Product	Chemistry	CAS Number	UV-Absorption nm	Melting point °C	Degree of yellowing	Rapid prototyping	Direct fabrication	Indirect fabrication
Esacure 3644	Type II	2243703-91-3	325,375	68-71	Medium	●●	●●●	●●●
Esacure KIP 160	Type I	71868-15-0	275	>96	Low	●	●●●	●●●
Omnirad 127	Type I	474510-57-1	243,332	45-50	Low	●	●●●	●●●
Omnirad 184	Type I	947-19-3	243, 331	44-50	Low	●●●	●●●	●●●
Omnirad 754		Proprietary	260, 340	Liquid *	Low	●●●	●●●	●●●
Omnirad 819	Type I	162881-26-7	237, 275, 380	127-133	Low	●●●	●●●	●●●
Omnirad 2022	Type I	Blend	245, 285 , 370	Liquid *	Medium	●●●	●●●	●●●
Omnirad 2100	Type I	Blend	220, 275, 370	Liquid *	Low	●●●	●●●	●●●
Omnirad TPO	Type I	75980-60-8	275, 379	91-94	Low	●●●	●	●●●
Omnirad TPO-L	Type I	84434-11-7	230, 275, 370	Liquid *	Low	●●●	●●●	●●●
Omnipol 910	Type I	886463-10-1	230, 325	Liquid *	High	●●	●●●	●
Omnipol ASA	Amine synergist	71512-90-8	230, 325	Liquid *	Low	●	●●●	●
Omnipol TP	Type I	1834525-17-5	360,395	Liquid *	Low	●●	●●●	●
Omnipol TX	Type II	813452-37-8	245, 280, 390	Liquid *	High	●	●●●	●

*: At room temperature

CATIONIC PHOTOINITIATORS

Product	Chemistry	CAS Number	UV-Absorption nm	Melting point °C	Degree of yellowing	Rapid prototyping	Direct fabrication	Indirect fabrication
Omnicat 250	75% solution of Iodonium, (4-methylphenyl)[4-(2-methylpropyl) phenyl]-, hexafluorophosphate(1-) in propylene carbonate	344562-80-7 + 108-32-7	240	Liquid at room temperature	Low	●●	●●●	●
Omnicat 270	High-molecular-weight sulfonium hexafluro phosphate	953084-13-4	240,290,320	192	Low	●	●●●	●●
Omnicat 440	4,4'-dimethyl-diphenyl iodonium hexafluorophosphate	60565-88-0	267	175-180	Medium	●	●●●	●
Omnirad 819	Sensitizer	162881-26-7	237, 275, 380	127-133	Low	●●●	●●●	●●●

Product	Chemical identity	Viscosity mPa.s at 25°C	Active conent (%)	Density g/cm3	Solvent	Product attributes	Rapid prototyping	Direct fabrication	Indirect fabrication
ADDITIVES									
Omnistab OB	2,5 thiophenediylbis (5-tert-butyl-1,3 benzoxazole)	Powder	> 99	1.272 @20°C	-	UV blocker, improves printing accuracy and definition	●●●	●●●	●●●

Product	Chemical identity	Functionality	Viscosity (mPa.s)	Temp (°C)	Tensile Strength (psi)	Elongation (%)	Tg (°C)	Product attributes	Rapid prototyping	Direct fabrication	Indirect fabrication
ACRYLATE OLIGOMERS											
Photomer 3016-25R	Bisphenol A epoxy diacrylate diluted with 25% TPGDA	2	15000	25	7800	5	45	Good reactivity and chemical resistance	●●●	●	●●
Photomer 6008	Aliphatic urethane triacrylate	3	16000	60	6800	8	47	High tensile properties, hardness and chemical resistance	●●	●●●	●●
Photomer 6010	Aliphatic urethane diacrylate	2	5800	60	2100	45	-7	Good flexibility, Non-yellowing	●●	●●●	●●
Photomer 6019	Aliphatic urethane triacrylate	3	3250	60	8200	8	51	High tensile properties, hardness , non yellowing	●●	●●●	●●
Photomer 6210	Aliphatic urethane diacrylate	2	12000	25	1400	40	32	Low viscosity, balanced mechanical properties	●●	●●●	●●
Photomer 6230	Aliphatic urethane diacrylate	2	3500	60	1100	70	2	Impact resistance, low odour, non-yellowing	●●	●●●	●●
Photomer 6645	Aliphatic urethane diacrylate	2	35000	25	994	760	-39	Very high elongation, excellent flexibility	●	●●●	●
Photomer 6710	Aliphatic urethane diacrylate	2	7500	25				Low viscosity, balanced mechanical properties	●	●●●	●●
Photomer 6891	Aliphatic urethane diacrylate	2	8000	25	2000	60	28	Flexibility, impact resistance, non-yellowing	●	●●●	●
Photomer Aqua 6903	Water dilutable urethane hexaacrylate	6	30000	25				Water-soluble 6F urethane acrylate for rigid, water-washable prototyping resins	●●●	●	●

Product	Chemical identity	Functionality	Viscosity mPa.s at 25°C	Tg (°C)	Surface tension (mn/m @ 25°C)	PDMS* Compatibility	Product attributes	Rapid prototyping	Direct fabrication	Indirect fabrication
ACRYLATE MONOMERS										
PureOmer 4012	Isobornyl acrylate (IBOA)	1	10	88	32	No	Hydrophobic, high solvency and thermal resistance, low shrinkage and surface tension with good flexibility. Bio-based Content (ASTM D6866-21) : 78 %	●●	●●●	●●
Photomer 4028	Bisphenol-A [4 EO] diacrylate	2	1000	63	43	Yes	Low shrinkage, low skin irritation, high reactivity and balanced mechanical properties	●●●	●●●	●●
Photomer 4039	Phenol [4 EO] acrylate	1	30	12	41	Yes	High flexibility, good solvency, low odor and low shrinkage	●●●	●●●	●●
Photomer 4127	Neopentylglycol [PO] diacrylate (NPGPODA)	2	15	35	32	Yes	Good reactivity and diluting power, low surface tension	●●●	●●	●●
Photomer 4141	Cyclic trimethylolpropane formal acrylate (CTFA)	1	15	40	36	Yes	Provides toughness, good solvency and chemical resistance with low shrinkage. Improves surface curing of finished parts made with flexible resins	●●●	●●●	●●●
Photomer 4149	Trimethylolpropane [3 EO] triacrylate (TMP3EOTA)	3	63	37	38	Yes	High reactivity, good diluting power, hardness with some flexibility	●●●	●●●	●●
Photomer 4184	2-[[butylamino)carbonyl]oxy] ethyl acrylate	1	35	-3		Yes	Flexibility, adhesion, high elongation, low odor	●●	●●●	●
Photomer 4250	Acrylated amine synergist	2.5	350				Amine acrylate, reduces oxygen inhibition to enhance curing speed and surface curing	●●●	●●●	●●●
Photomer 4356	Tris (2-hydroxy ethyl) Isocyanurate triacrylate (THEICTA)	3	Wax	240		Yes	High Tg and thermal resistance, high reactivity and hardness	●	●●●	●●●
PureOmer 4812	Lauryl acrylate (LA)	1	7	-30	30	No	Hydrophobic, high solvency and flexibility, low shrinkage and surface tension. Bio-based Content (ASTM D6866-21) : 81 %	●●	●●●	●

METHACRYLATE MONOMERS

Product	Chemical identity	Functionality	Viscosity mPa.s at 25°C	Tg (°C)	Surface tension (mn/m @ 25°C)	PDMS* Compatibility	Product attributes	Rapid prototyping	Direct fabrication	Indirect fabrication
PureOmer 2012	Isobornyl methacrylate (IBOMA)	1	6	150	31	No	HAdhesion, flexibility, low shrinkage, abrasion resistance, high Tg (150) Bio-based Content (ASTM D6866-21) : 72 %	●	●●●	●
Photomer 2318	Hydroxyethyl Methacrylate (HEMA)	1	5	55		Yes	Low odour, excellent diluent for urethanes, water soluble	●	●●●	●●

VINYL MONOMERS

Product	Chemical identity	Functionality	Viscosity mPa.s at 25°C	Tg (°C)	Surface tension (mn/m @ 25°C)	PDMS* Compatibility	Product attributes	Rapid prototyping	Direct fabrication	Indirect fabrication
Omnimer ACMO	Vinyl monomer; acryloymorpholine	1	12			Yes	Hydrophilic monomer for water-washable resins, excellent reactivity and thermal resistance, low shrinkage and good flexibility. Excellent surface curing of finished parts	●●●	●●●	●●

* Polydimethylsiloxane

Product	Chemical identity	Viscosity @25°C 'mpa.s)	Colour max (Apha)	Product attributes	Rapid prototyping	Direct fabrication	Indirect fabrication

CATIONIC OLIGOMERS

Product	Chemical identity	Viscosity @25°C 'mpa.s)	Colour max (Apha)	Product attributes	Rapid prototyping	Direct fabrication	Indirect fabrication
Omnilane OC 1005	(3-4-epoxycyclohexane) methyl3'-4'-epoxycyclohexylcarboxylate	400	100	Cycloaliphatic epoxide for cationic curing, provides hardness and good reactivity	●●	●●●	●●
Omnilane OC 3005	Bis(7-oxabicyclo[4.1.0]hept-3-ylmethyl) adipate	575	250	Bis(7-oxabicyclo[4.1.0]hept-3-ylmethyl) adipate	●●	●●●	●●

Depending on regulation, all products may not be available in your country, For further registration information, please contact your local sales representative.

GOING FURTHER

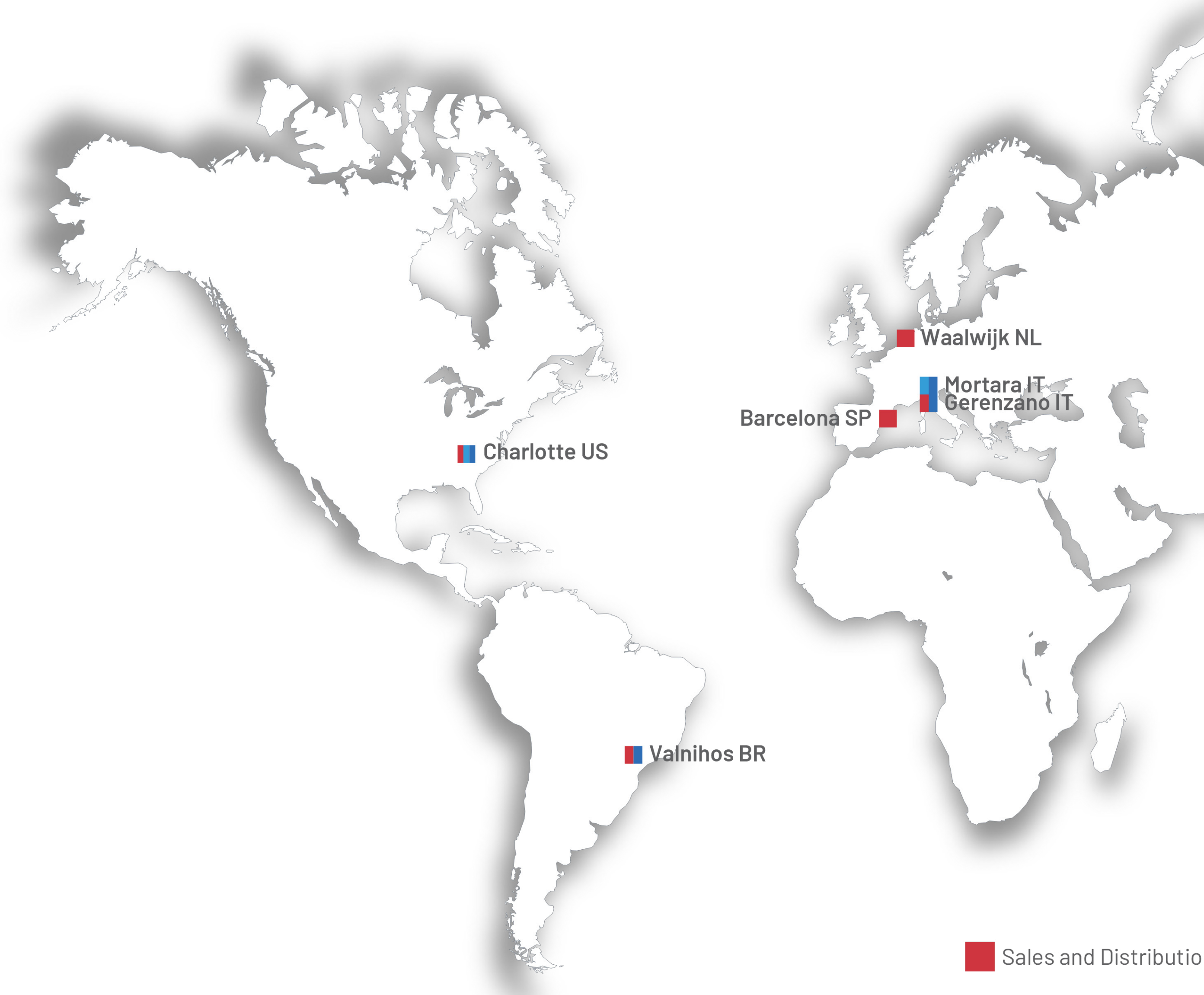
Faster selecting the most adapted photoinitiators, energy curing resins, and additives, the following formulation tricks can help you to enhance inhibition mechanism in depth for a better radical polymerization :

- Increasing the photoinitiator concentration will create an auto-inhibition phenomenon but it will increase the yellowing,
- Adding UV absorber, Fluorescent Optical brighteners such as Omnistab OB, Omnistab OB-1
- Adding inhibitor such as Omnistab BHT, Omnistab MeHQ, Omnistab PTZ,
- Oxygen Inhibition with higher viscosity formulation. Oxygen inhibition is a “plus” in free radical polymerisation to avoid residual liquid to prematurely cure on the surface of the printed objects,
- Using higher photoinitiators concentration with a lower reactivity such as Omnipol TP.

Our technical team is here to offer you support and advice to help you meet your goals. For our full product range, please refer to the UV/EB Radcure Product Guide or visit our website.

Contact information

IGM Resins in the world



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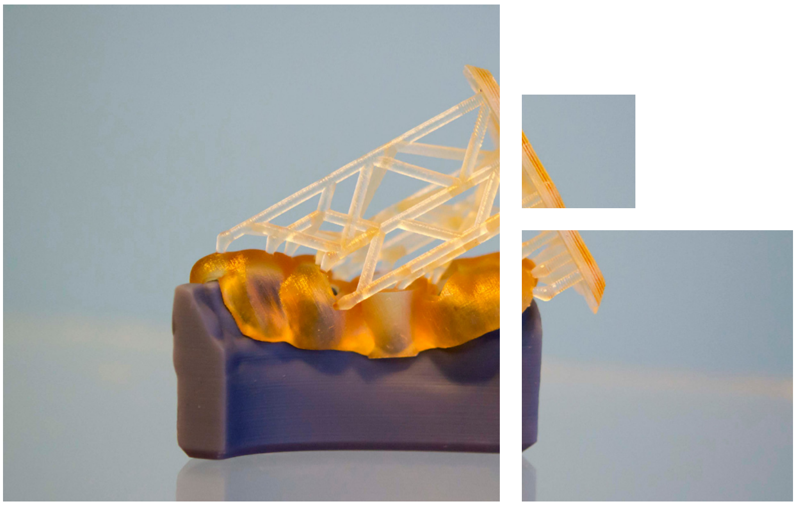

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