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Novel Ge- and Sn-based initiators for light induced radical polymerization of dental resins

B Gebhardt, U Fischer and **N Moszner**
Ivoclar Vivadent AG

Polymerization of light-curing dental materials is initiated using camphorquinone (CQ) (λmax = 468 nm) with tertiary arylamines (Norrish-II type) at wavelengths of 400-500 nm. Alternatively, acylphosphine oxides (APO; λmax = 385 nm) and bisacylphosphine oxides (BAPO, λmax = 397 nm) are used to avoid discoloration by arylamines. The low solubility of BAPO and limited VIS-absorption of APO limit their potential for many applications.[1, 2] The strong absorption and scattering of wavelengths between 390-420 nm in methacrylate-based restorative materials limit the depth of photocure (DOC) achievable in acceptable periods of time. To achieve the 4 mm DOC demanded from so-called „Bulk-Filling" restorative composites, the bisacyl-germane based (BAGe) initiator Ivocerin® (λmax = 408 nm) was developed.[3, 4, 5] For further improvement of DOC, bathochromically shifted Initiators are investigated. Novel Ge- and Sn-based initiators, such as tetraacyl-germane (TAGe) and -stannane (TASn) initiators are herein discussed in comparison to Ivocerin®.[6, 7, 8] While λmax of TAGe and TASn show no bathochromic shift relative to Ivocerin, the absorption at 440-480 nm overlaps significantly better with the emission spectrum of dental light-curing unit (LCU). TAGe's and TASn's rapid photolysis results in complete and irreversible bleaching within 10 s irradiation using a LCU (390-510 nm). Dental composites comprising equimolar concentrations of initiators (0.2 wt.% BAGe, 0.4 wt.% TAGe and TASn) were compared regarding DOC at different wavelengths (400-517 nm). Here, TASn gave an increased DOC at higher wavelength in comparison to BAGe. The presented systems are highly interesting alternatives to commercially available photo initiators. Their highly effective radical generation, excellent photobleaching, excitation at biocompatible wavelengths and low toxicity of photolysis products offer great potential for a variety of different medical and industrial applications.

Recent Publications:

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3. Moszner N., Zeuner F., Lamparth I., Fischer U. K. (2009) Benzoylgermanium Derivatives as novel visible-light photoinitiators for dental composites; Macromol. Mater. Eng. 294 877-886
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5. Moszner N., Burtscher P., Vogel K., Todd J., Heintze S., Peschke A., (2013) Ivocerin – ein Meilenstein der Composite-Technologie; Ivoclar Vivadent Report Nr.-19.
6. Moszner N., Fischer U. K, Lamparth I., Fässler P., Radebner J., Eibel A., Haas M., Gescheidt G., Stueger H. (2017) Tetraacylgermanes as highly efficient photoinitiators for visible light cured dimethacrylate resins and dental composites; J. Appl. Polym. Sci., 135, 46115
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Biography

Dr. Benjamin Gebhardt joined Ivoclar Vivadent AG in 2012 after his PhD at ZPM in Fürth (Friedrich-Alexander University Erlangen-Nuremberg). He started his career in the development of adhesives and self-adhesive dental materials. In 2014 he changed his focus to the development of resin based dental restorative materials. One of his major fields is the development of light and dual-cured bulk-fill composites. Since 2018 he is head of the composite department at Ivoclar Vivadent AG.

Benjamin.gebhardt@ivociarvivadent.com

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