

Novel photo acid generator for cationic polymerization and Resist Technology

BACKGROUND^[1]

Cationic photopolymerization is currently used in a variety of applications like coatings (e.g. silicon release, decoration and protection coatings), lithographic techniques, resists, printed circuit boards. The initiating species in cationic photopolymerization is generated due to (UV)-light induced cleavage of so called photo acid generators (PAGs). The state of the art PAGs are usually iodonium or sulphonium salts of fluorometallate anions (e.g. BF_4^- ; PF_6^- ; AsF_6^- ; SbF_6^-) or $[\text{BAR}_4\text{F}]^-$ -anions. These anions suffer from different drawbacks like toxicity, hydrolysis or tough synthesis and therefore high price.

Cationic photopolymerization offers not only wide range of polymerizable monomers (e.g. epoxides, oxetanes, vinyl ether) but also a clear advantage compared to the classical free radical photopolymerization, which is the independence of the process from oxygen. Therefore a broad (expanding) field of applications opens for a novel PAG.

TECHNOLOGY

We investigated a new aluminum based PAG which is easy to synthesize^[2, 3] (sulphonium as well as iodonium salt) at high yields. The educts are inexpensive and commercially available. Furthermore it shows a remarkable stability against hydrolysis^[4]. This high stability and the abandonment of any heavy metals in our novel PAG prompts a low toxicity. The high stability against hydrolysis is a consequence of the almost perfect steric shielding and electronic stabilization of the used fluorinated alkoxy aluminate. A further benefit of this shielding / stabilization is a good solubility of the PAG in all, until now examined, monomers.

The reactivity was also tested in different monomers and found to be at least on a par with other state of the art acid generators. In several cases the reactivity of our novel PAG is clearly superior to the state of the art systems. Especially the high reactivity towards the usually rather inactive glycidylethers (e.g. Bisphenol A diglycidyl ether BADGE) is remarkable. Also a remarkable high polymerization rate in the first few seconds of the polymerization could be observed. This is of importance for coating applications since this value determines how long it takes to achieve a tack free surface and limits therefore often the whole speed of production. Despite the high reactivity of our novel PAG no reduced pot life was observed.

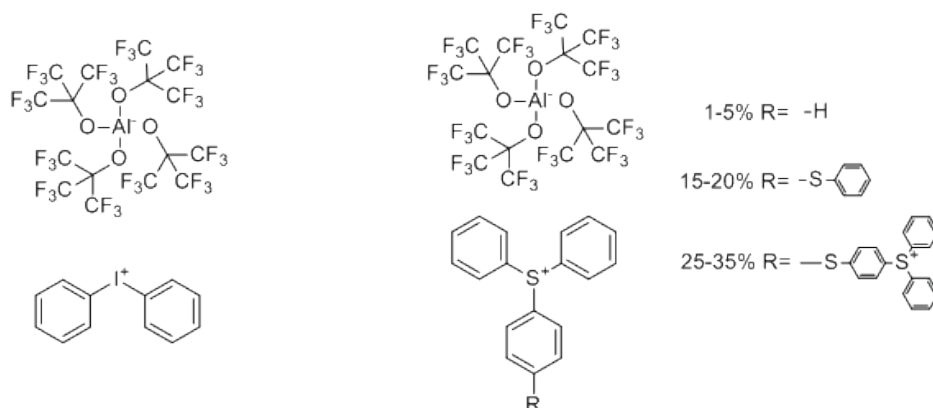


Figure 1: Iodonium- and Sulphonium-form of our novel aluminum based PAG

REFERENCE:
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KEYWORDS:
PAG, Photo acid,
Epoxy resins,
Cationic Polymerization,
Iodonium, Sulphonium,
Coating

APPLICATIONS:

- Coatings (e.g.: release, decoration, protection coatings)
- Lithographic techniques
- Resists
- Printed circuit boards
- Chemical anchor bolts
- Production of composite materials on epoxy base

IPR:

AT and EP granted,
US, JP pending

OPTIONS:

License agreement

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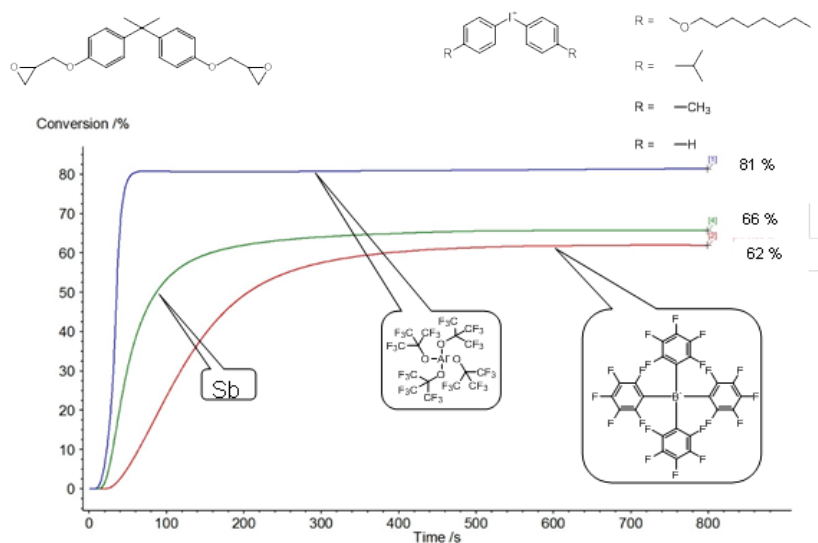


Figure 2: Comparison of different PAGs in BADGE utilizing a photo DSC

ADVANTAGES

- Common and commercial available educts
- Easy synthesis
- Rapid curing due to high reactivity
- Good results with low reactive epoxy resins like BADGE
- Expected low toxicity
- High pot life due to high stability against hydrolysis

FURTHER READING

1. Dietliker, *Chemistry and Technology of Uv and Eb Formulation for Coatings, Inks and Paints*, ed. Oldring. Vol. 3. 1991.
2. Robert A Gossage, et al., *Experiments in Green and Sustainable Chemistry*. 2009: Wiley-VCH.
3. Liska, R., et al., *Photoinitiator for cationic polymerization*, 2015, AT Patent application
4. Krossing, I., *1.23 - Weakly Coordinating Anions: Fluorinated Alkoxyaluminates*, in *Comprehensive Inorganic Chemistry II (Second Edition)*, J.R. Poepelmeier, Editor. 2013, Elsevier: Amsterdam. p. 681-705.

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