New Phosphine Oxide-based Photoinitiator

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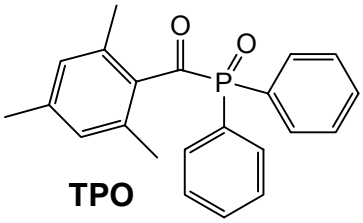
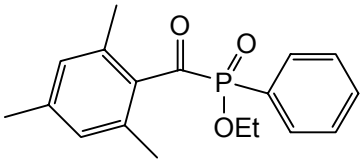
A novel acyphospine-oxide (APO) compound was synthesized and evaluated as a photoinitiator for a clear resin system. The photospeed of APO was far slower than that of the current commercially available APO type photoinitiators, but offers potential for further improvement.

Introduction

APO photoinitiators are a class of photoinitiator which have been used widely since its first introduction in the early 1980s'. Monoacrylphospine oxide (MAPO) photoinitiators were the first generation introduced, and were applied to give satisfactory curing for a white-pigmented and thick UV system. Two commercial products are shown below.[1]

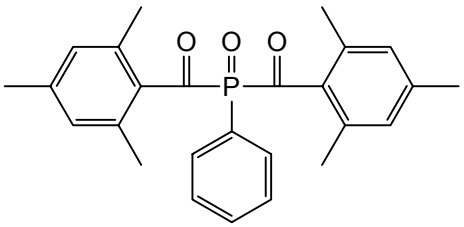


TPO

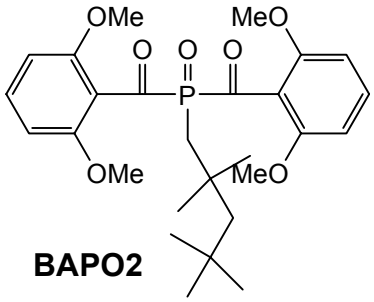


MPO

The introduction of bisactylphosphine oxide (BAPO) photoinitiators in the late 1990s' has opened the door for sun light curing and further improved photospeed. Two commercially available products are shown below.[2]



BAPO1



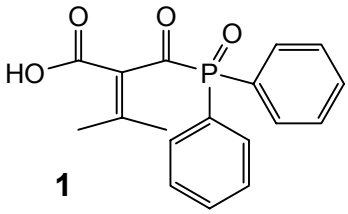
BAPO2

Experimental

Recent research on APO type photoinitiators has resulted in several patents in which a few new APO compounds were introduced.[3] However, most of these studies have focused on changing the substitution on the phosphine functional group.[4] Few studies

have attempted to understand the role of the acyl group. Since the alkyl group usually renders non-yellowing and improved solubility to the molecule, we are working to replace the aromatic group of TPO's with an alkyl group.

An APO compounds **1** shown below was designed and synthesized. The UV spectrum of this molecule does not show a distinguished UV absorption pattern at 360-400 nm.



1

The photospeed was evaluated using a clear formula and the result is shown below. APO1 was used as a comparison.

Table 1. Clear coating formula and curing speed

	Formula 1	Formula 2
Compound 1	2	-
TPO	-	2
Chivacure 184*[1]	0.5	0.5
TMPTA	35	35
Bisphenone A epoxy acrylate*[2] (gram)	62.5	62.5
Curing Speed*[3] (ft/min)	25	200

*1 Available from Chitec Technology
*2 Available from UCB Chemical
*3 Light source is Fusion D bulb with 300 W/inch

Conclusion

The first new non-aromatic acyl phosphine oxide synthesized has shown some degree of photoinitiator activity. This success implies that replacing the aromatic group attached the carbonyl group is possible for the new APO molecule design which has the potential to develop a new photoinitiator with an improved non-yellowing and solubility profile.

Reference

[1] Crivello, J. V.; Dietliker, K. Photoinitiator for free radical, cationic & anionic photopolymerisation, 2nd edition; 1998; p.168

[2] A compilation of photoinitiators commercially available for UV today; 2002, p. 63

[3] Al-Akhdar W. et al; US Patent 6486226 (2002)

[4] Schroeder, J. et al; US patent 5410060 (1995)