

## The Syntheses and Properties of UV-stabilizers by using Hydrosilylation Method

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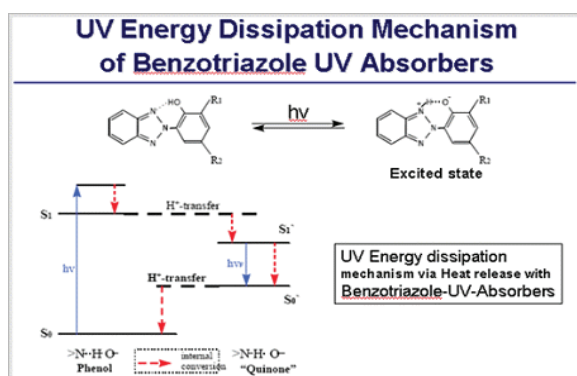
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### 1. INTRODUCTION

A UV-stabilizer is a product which is designed to prevent or slow degradation caused by exposure to ultraviolet radiation. The UV light or radiation shows the formation of free radicals due to the breaking of molecular bonds on organic compounds. The free radicals thus formed react with atmospheric oxygen to form peroxy free radicals. Generally, this behaviour is called auto-oxidation process. Degradation caused by UV exposure can be a serious problem with a wide range of products, and is generally undesirable.

We often classify the types of light or UV stabilizers which make according to their action mode: UV absorbers (UVAs) that act by shielding the organic compounds from ultraviolet light or hindered amine light stabilizers (HALS) that act by scavenging the radical intermediates formed in the photo-oxidation process.

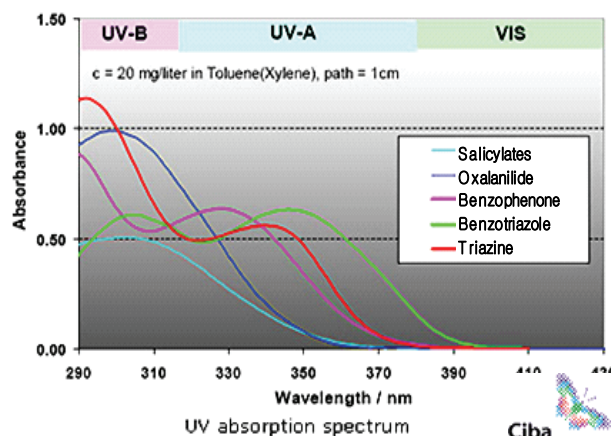


**Fig. 1.** UV energy dissipation mechanism of benzotriazole-type UV absorbers.

UV absorbers have the property to convert the energy absorbed from UV light into heat, via a mechanism called keto-enol tautomerism. This heat can then dissipate through the substrate. By this cyclic mechanism, UV absorbers can have UV-stabilization effect during the life-time of organic compounds. UV-stabilizers based on 2-hydroxy-

benzotriazole and benzophenone derivatives would be used for the functional materials such as paper, textile, cosmetic, and plastic, etc.,

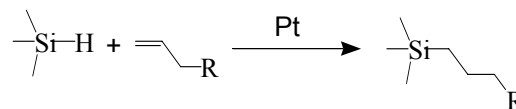
In this study, we prepared the hybrid (organic – inorganic) UV-stabilizers by using hydrosilylation method and investigated physical and spectroscopic properties.



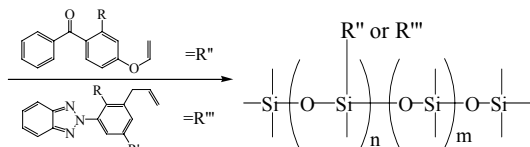
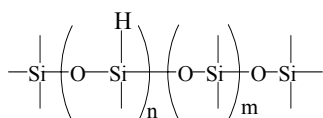
**Fig. 2.** UV absorption spectrum of UV-stabilizers

### 2. EXPERIMENTAL and RESULTS

**General procedure for the Hydrosilylation:**



The silicon compound and allyl-functionalized UV-stabilizers were dissolved in toluene (dried with  $P_2O_5$ ). The reaction mixture was stirred under Ar gas, and then added a mixture of silicon compounds with Pt catalysis. The reaction was heated under refluxing for several hours and then cooled to room temperature. The mixture was evaporated under reduced pressure and dried at high vacuum (40 mTorr) to obtain hybrid (organic - inorganic) UV-stabilizers as a liquid form. (Yield > 95 %).

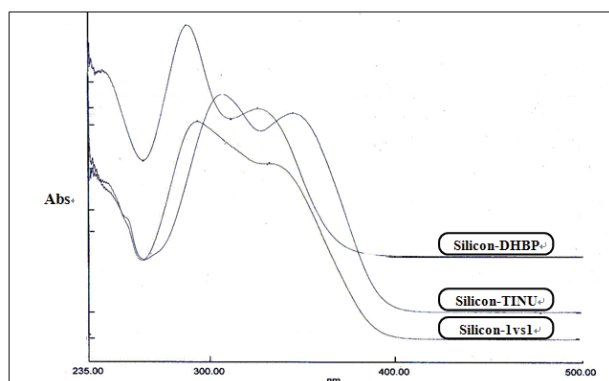


**Scheme 2.** The synthetic route of UV-stabilizers

Spectroscopic properties of UV-stabilizers (absorbance 290 ~ 350 nm) were shown in Table 1.

**Table 1.** Spectroscopic properties of UV-stabilizers

Compound	$\lambda_{\text{max1}}$ (nm)	$\lambda_{\text{max2}}$ (nm)	$\epsilon_{\lambda_{\text{max1}}}$ ( $\times 10^4 \text{ M}^{-1} \text{ cm}^{-1}$ )	$\epsilon_{\lambda_{\text{max2}}}$ ( $\times 10^4 \text{ M}^{-1} \text{ cm}^{-1}$ )
HMDS-05_ _DHBP	326	288	4.9	7.6
HMDS-05_ _Tinu	345	307	6.1	6.7
HMDS-05_ _R:R'(1:1)	332	294	5.3	6.6
OMDS-007 _DHBP	323	288	1.7	2.8
OMDS-007 _Tinu	344	308	2.7	2.9
OMDS-007 _R:R'(1:1)	336	296	2.1	2.5



**Fig. 3.** UV-spectrum of compounds (DHBP : Dihydroxybenzophenone derivatives, TINU : 2-Hydroxybenzotriazole derivatives, 1 vs 1 : mixture of DHBP and TINU)

### 3. CONCLUSIONS

We synthesized the hybrid (organic - inorganic) UV-stabilizers as a liquid form. They were absorbed both UV-A (320 ~ 400 nm) and UV-B (290 ~ 320 nm). UV-stabilizers based on silicon compounds had

a good solubility in various organic solvents, and high SPF (Sun Protection Factor) compared to standard materials.

### 4. REFERENCES

- [1] H. Friedrich, I. Jansen, and K. Rühlmann., "Journal of Inorganic and Organometallic Polymers", Vol. 1, No. 3, 397-415 (1991).
- [2] Qiufeng An, Linsheng Li, Dedai Lu, Liangxian Huang., "Journal of applied polymer science", Vol. 104, 680-687 (2007).
- [3] Shin-Liang S. Yang; U.S. Patent No. 5466768, May 6 (1994).
- [4] Koji Sakuta; U.S. Patent No. 5254542, Sep. 25 (1991).