UV Active Silanes: The Synthesis and Application as Bird-deterrent Glass Coatings

Joel Zazyczny, Youlin Pan and Barry Arkles
Research and Development, Gelest Inc.
11 East Steel Road, Morrisville, PA 19067, USA

Enabling Your Technology

Background

Ornithologists estimate that up to one billion birds are killed each year in the United States by collision with windows and glass panels in homes, commercial buildings and sports stadiums. The collisions are primarily due to the transparent and reflective nature of glass. In the case of transparent glass, birds see an open path, and in the reflective glass, birds see images that appear as a mirror showing familiar escape routes, and thus, fly unaware into the window or other glass panels to their demise.

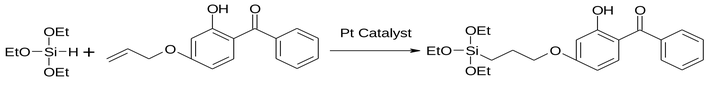
The white–throated sparrow is the most frequent collision victim in New York City.

Approach

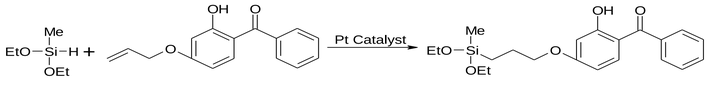
Many attempts to address the problem of bird collision have been reported, these include placing objects, or netting on or in front of window glass panels. Our approach to resolving this issue is the development of UV active silanes/UV-absorbing coatings, and applying such coatings to windows or glass exterior-face surfaces. The treated windows or glass panels will provide sufficient optical absorption to make their surfaces visible to birds and act as a deterrent to birds flying toward those surfaces. [***US20070190343A1]***

Target Compounds

2-Hydroxy-4-(3-Triethoxysilylpropyl)diphenylketone (SIH6200.0) Compound A



2-Hydroxy-4-(3-Methyldiethoxysilylpropyl)diphenylketone (SIH6198.0) Compound B



Synthesis

Hydrosilylation of the uvinol with methyldiethoxysilane, or triethoxysilane in the presence of Pt-catalyst under mild conditions results in the formation of compound A and B in 60 to 80% yield. Purification can be achieved with wiped film distillation. The structures of both compounds have been confirmed by conventional analytical methods including FTIR, and 1HNMR. The purity of compound A and B has been determined by HPLC.

Coating Formation

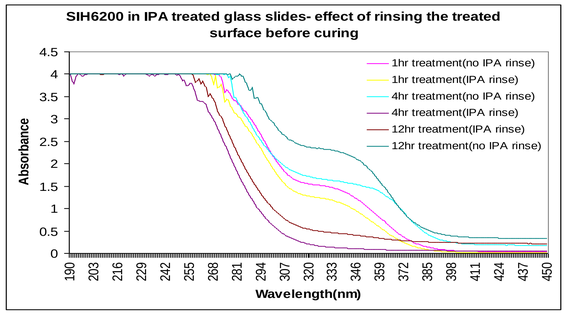
1.Formulation of UV active coating

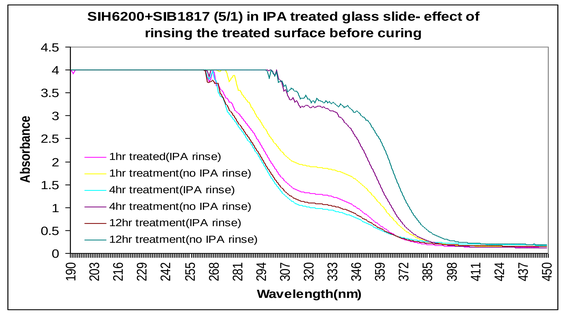
Main resin: SIB1660.0
Catalyst: SND2950
Adhesion promoter: SIB1817.0
UV active silane: SIH6200.0
Solvent: Acetone

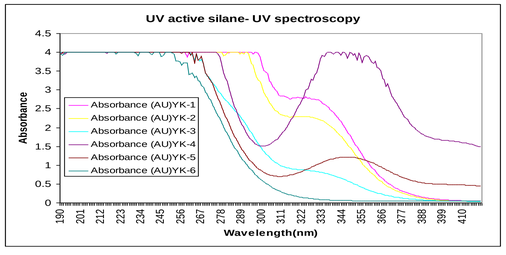
2. Samples

YK-1: 1% SIH6200.0
YK-2: 1% SIH6200.0
YK-3: 0.5% SIH6200.0
YK-4: 1% SID4352.0
YK-5: 0.5% SID4352.0
YK-6: untreated borosilicate glass slides

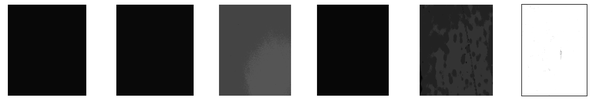
Glass Surface Treatment: A 10% solution of compound B is prepared in ethanol, IPA, acetone respectively, along with water and acetic acid. Water in the amount of 1.5 mol is added to the solution. The solution is aged twenty minutes to allow partial hydrolysis of the ethoxy groups. The solution is then applied to at least a part of the transparent or translucent exterior surface, i.e. commercial building window, in the form of an aerosol spray or a resin. Dipodal silane,1,2-Bis(triethoxysilyl)ethane (SIB1817.0) was mixed with compound B to improve bonding strength to the glass surface. A UV analysis of those glass slides is depicted as follows:







UV Microscopy (Transimitted) at 320 nm



UV Microscopy (Transimitted) at 365 nm

Wavelength from 300nm to 400nm is visible to birds but transparent to humans. UV spectroscopy confirmed the absorbance of UV light from the UV active silane coated surface compared to the untreated glass slide. In addition, UV microscopy presents dark images at UV wavelengths from the UV active silane treated surface relative to the transparent image on untreated glass slide (YK-6).

Lab and field experiments to understand the effectiveness of the treated windows and glass panels in homes, commercial buildings and sports stadiums are currently under investigation.

Conclusion

- Two hydroxy diphenylketone-containing organosilanes were synthesized and purified.
- The UV-absorbing and antireflective organosilanes coatings for transparent or translucent coatings were formulated.
- The coating resin was applied to glass substrates by dipping or in the form of aerosol spray.
- Abating bird-strikes on glass can be achieved with a non-reflective UV opaque coating based on new siliceous resins.