# *TISS coating as added value for polymeric solar absorber* **INFO** Sheet C4

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| Description | *TISS coating as added value for polymeric solar absorber* |
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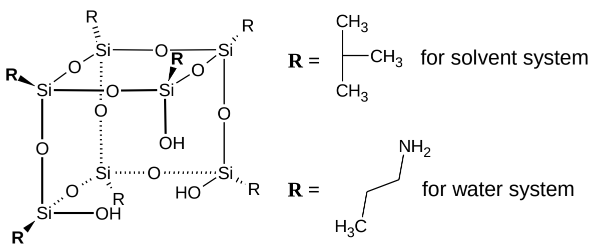
## Introduction

Polymer based solar collectors are one of the important parts of modern architecture. Market demands are oriented to the colored absorbers to fulfil the demand of architects and integrate the collectors in new buildings. One of the options for production of colored collectors is usage of the Thickness Insensitive Spectrally Selective (TISS) paints. TISS paints are tailor-made, multifunctional materials based on a variety of organic macromolecules and functional and processing additives. The material aspects of the colored TISS paint coatings are focusing on pigments, metallic and metallized flake pigments and polymeric resin binders used for the production of solar paint coatings with the help of dispersant molecules in order to achieve uniform distribution of the finely ground pigment particles in the polymeric resin binder. An important prerequisite for the successful selection and use of pigments in solar-thermal systems is the usage of high absorptivity pigments with their high loading in combination with the low thermal emitting binder. The addition of various organic or inorganic pigments changes the black color of the TISS coatings to other shades characterized by color coordinates a, b and chroma C, which differ from those of black TISS coatings but retain the spectral selectivity determined with $a_s$≈0,88–0,92 and $e_T$≈0.28–0.43. For industrial application beside the mentioned optical values also low paint surface free energy, adhesion, hardness, weathering resistance thermal and UV stability are important demands. In this info sheet a proposed option for the preparation of paints for solar-thermal systems is described on the basis of Polyhedral Oligomeric SilSesquioxane (POSS) molecules. Relevant features and properties are exemplarily depicted for solvent and water based binders.

## Pigment modification by silsesquioxane molecules

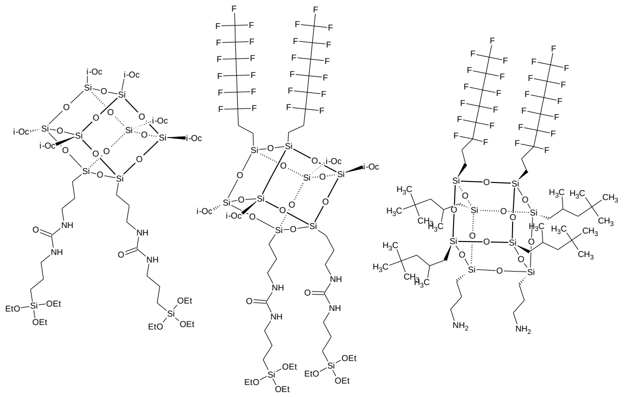
Appropriate pigment dispersion is the key point for obtaining TISS coatings. The pigment dispersion should allow in combination with metallic pigment and binder deposition of thin (≈500–1500 nm) layer over the top flakes in order to impart pigment/metal tandem stack low thermal emittance ($e_T$). At the same time this tandem must ensure high solar absorptance ($a_s$). This is achieved when the coating consists of well-dispersed non-agglomerated pigment particles, preferentially smaller than ≈150 nm. Binder selection is very important in this step.




*Proposed molecules for pigment surface modification.*

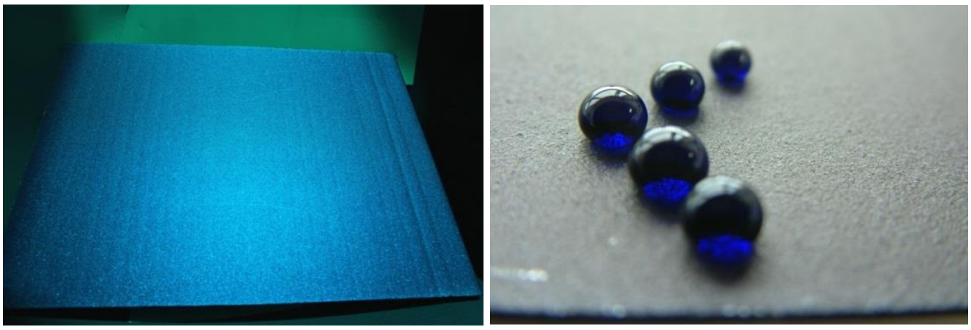
## Tuning of the free surface energy by silsesquioxane molecules

Low surface energy is an important aspect. It is reflected in low dew collection, low dust and pollen collection and prevention of dirty water evaporation from the coating surface of glazed and unglazed solar absorbers. Low free surface energy is expressed with a high contact angle for water (>140–150°) and small (α<5–10°) sliding angle of water drops. We have achieved low surface energy by incorporating various POSSs molecules into the structure of TISS paints prepared in our laboratory.



*POSS molecules proposed as an additive for decreasing free surface energy of TISS coatings.*

## Features and properties of TISS paint coatings



*Colored TISS coating on PPS absorber (left) and colored water droplets on TISS paint surface (right).*

## Summary and conclusions

The presented silicon compounds allow on one side modification of the pigments and on the other side modification of coatings surface. Both modifications are necessarily for industrial coating demand for polymeric absorbers used for solar-thermal applications. POSS molecules are UV, thermal and weathering resistant. Furthermore, the formulations with proposed additives are candidates for industrial application.

## Recommended literature

Jerman, I., Orel, B., Koželj, M. (2012) In: Polymeric Materials for Solar Thermal Applications (Köhl, M. et al., eds), pp. 271-290, Wiley-VCH, Weinheim.

Jerman, I., Mihelčič, M., Vrhovšek, D., Kovač, J., Orel, B. (2011) Solar Energy Materials and Solar Cells, 95, 2, 423-431.