



Polysil DL

Double Layer Coating

Nanotechnology evolution:
coatings with high infrared reflectance



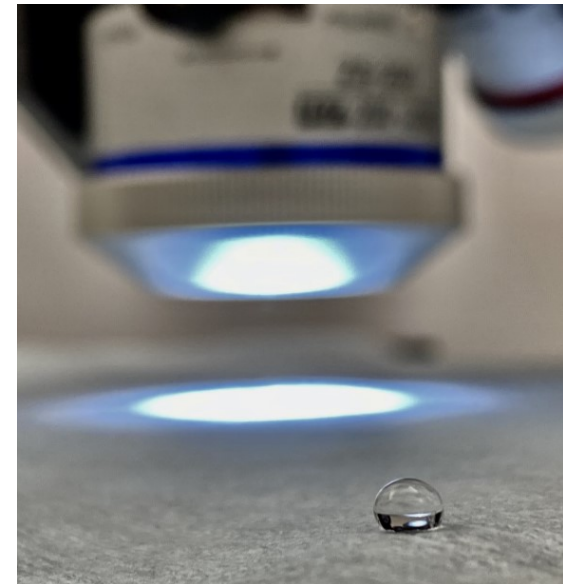
Nanoprom



Nanoprom is an Italian company, pioneer in research and industrial application of nanomaterials.

Since the late '90s, the company is active in research of nanomaterials based on silica and develops Polysil®.

In this context, Nanoprom has developed a structured silicon coating for thermal insulation with excellent thermal and mechanical characteristics, the coating is fire-resistant and can be added with specific materials such as metal oxide to reduce the absorption and transmission of infrared radiation.



Health and Environment

Nanoprom develops its own proprietary products with full respect of health and environment. All the components used for Polysil have been subjected to toxicological and environmental controls. In addition to that the top-level safety of our nanotechnology-based products is ensured by numerous severe tests passed before introducing them to the market.

Therefore, all the products of the Polysil family guarantee the protection of health and the environment for the following reasons:

- The starting components are non-toxic.
- Only components bonded in nanolayers are used.
- The spray drops are not breathable.
- The nanocomponents are attached to the surface without delamination or particulate release.



Polysil: sol-gel silica coating

The Polysil is a unique kind of nanomaterial coating based on sol-gel silicon.

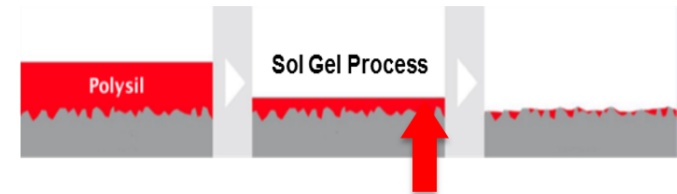


With air moisture the Polysil start its polymerization process in which nanoparticles are arranged on the surface in several thin layers self-organizing, providing a highly stable and comprehensive protection. Typical layers can range from 5 μm to 20 μm , and their adhesion to the substrate can be mechanical and covalent-type (chemical). Furthermore, its formulation and process allow for the inclusion of engineered nanomaterials for adding extra properties to the coating, such as increased surface heat transmission, enhanced hydrophobicity, etc.

Polysil® the "Liquid Glass"

PROCESS

- Nanoparticles are arranged on the surface in several thin layers self-organizing.
- With air moisture the Polysil start its polymerization.
- Typical layers can range from 5 µm to 10 µm



APPLICATION FIELDS

- Automotive/Racing
- Maritime (civil and military)
- Aerospace (civil and military)
- Mechanics



Boat



Mechanics



Racing



Aerospace



Design

MAIN FEATURES

- Room temperature process
- Nanomaterials can be included
- Layer Thickness = 0,5 - 50 µm
- Covalent Adhesion to some substrate

Nanoparticle Surface Enhancements



Water repelling



Fireproof improvement



Dirt Adhesion repelling



Surface Heat Transmission

Silica Aerogel for Thermal Insulation Coatings

Polysil offers usability up to 650° C continuously and up to 980° C for short periods.

To improve its use as a coating for high temperature operations, the ability to thermally insulate the protected surface has been implemented.

Silica Aerogel, when used as additive in the coating manufacturing process, increase chemical resistance, corrosion resistance, weatherability and other effects on rheology.

With a thermal conductivity half that of still air, offers ultra low thermal conductivity.

Delivers exceptional burn protection, superior heat transfer resistance and improved energy efficiency.

Polysil has a low thermal conductivity of 0.6 W/mK, thanks to the use of the Silica Aerogel the **Polysil Thermal Shield has a thermal conductivity of 0.015 W/mK**



Infrared Radiation and Thermal Infrared Reflectivity

Silica aerogel, which is made of nanoporous matrix with interconnected amorphous silica nanoparticles, offers complementary performance to IR reflective coatings.

By appropriately doping of the Polysil TS coating, it is possible to make it reflective of infrared radiation.

The low infrared transmission in combination of the very low thermal conductivity makes it an ideal material for roofing.

There are many materials that can be used to reflect infrared, each characterized by a different operating band.

Infrared Radiation and Thermal Infrared Reflectivity

Some doping materials.

| | TiO ₂ | SnO ₂ | Cr ₂ O ₃ |
|---|--|---|--|
| Reflectivity Spectral Range (nm) | 388 – 413 | 620 – 640 | 700 – 2500 |
| Beneficial Parameters | Near and mid-range infrared reflectivity, band gap controlled by doping level. | Mid-range infrared reflectivity, band gap controlled by doping level. | Mid to far-range infrared reflectivity |

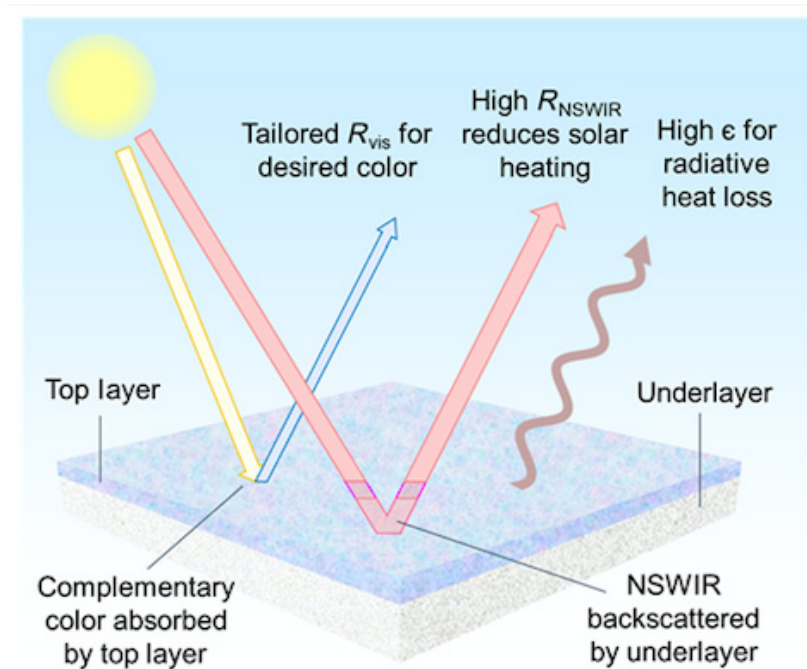


Double-layer coating for Infrared Reflectivity

Solar reflective and thermally emissive surfaces offer a sustainable way to cool objects in sunlight. However, the coloring of these surfaces does not meet the building industry's need for color.

A double-layer coating that simultaneously achieves color and radiative cooling can be obtained by applying an aesthetic paint on the specific version of Polysil TS.

The bilayer design, with a thin colored layer atop a thin infrared-scattering underlayer with low thermal conductivity, can address the problem.

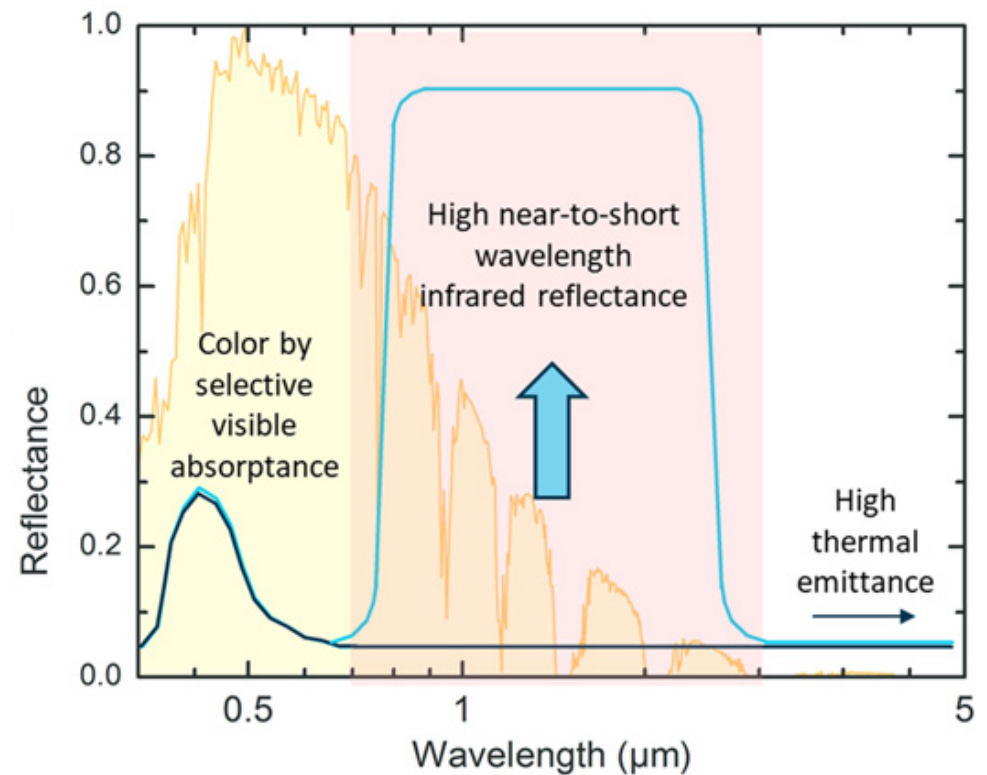


Double-layer coating for Infrared Reflectivity

The top layer selectively absorbs visible wavelengths complementary to the desired color but not others, while the underlayer maximizes the backscattering of any sunlight transmitted by the top layer.

The low thermal conductivity helps to isolate the underlying surface from the heat transmitted by contact with the top paint layer.

The bilayers exhibit near-identical colors to those of commercial monolayer.



Performance

Unfortunately, at the moment the product is under development and the results cannot be disclosed, however we can affirm that the first results are very interesting and if confirmed with the continuation of the development, the product will rival the best competitors on the market.

However, this application will initially be an aerospace and racing application designed to protect carbon fiber composite parts from heating.

For more information and development updates keep in touch: l.macera@nanoprom.it





ITALIAN QUALITY

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