



Clever combination increases solar cell efficiency

Vindico Surface Technologies B.V., a joint venture enterprise from Hardinxveld-Giessendam, has applied for a patent on Vindico PV+. This is a low soiling coating with anti-reflective properties. Vindico PV+ increases the efficiency of solar panels (photovoltaic (PV) cells).

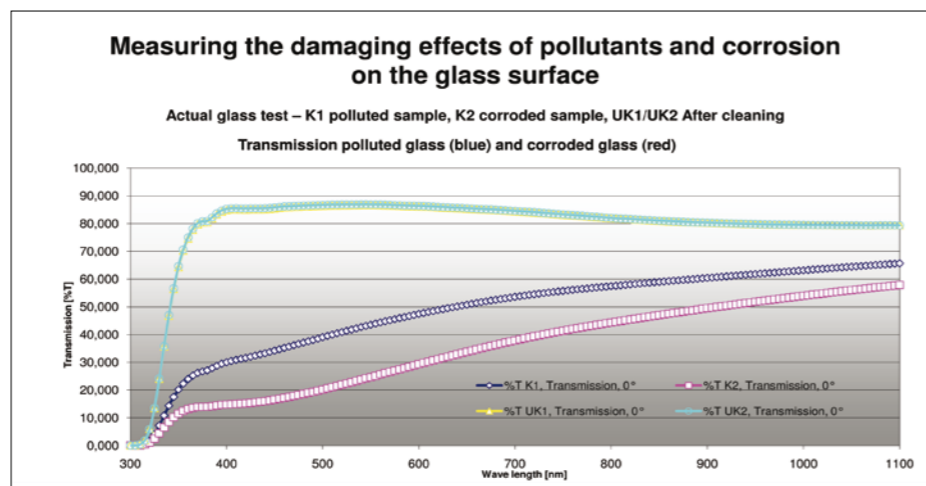
The efficiency of solar panels is dependent on the amount of sunlight which reaches the photovoltaic cells. Contamination and reflection are factors which reduce efficiency. Vindico Surface Technologies B.V. has developed a durable low soiling coating for photovoltaic glass, which is combined with an anti-reflective coating. This product is marketed under the name Vindico PV+.

Patent

The patent application has been submitted for the application of a durable low soiling coating on a transparent substrate for photovoltaic cells which have been given an anti-reflective layer to increase the transmission of sunlight by the substrate. The usual anti-reflective coatings with layers of plasma deposits (process chemical vapour deposition (CVD)) or combustion chemical vapour deposition (CCVD)) have an open structure which quickly becomes contaminated. Cleaning encases the dirt in the open structure, resulting in a reduction of the efficiency of the solar cells.

CCVD with sol gel

The anti-reflective layer of Vindico PV+ is created by a CCVD process and for the low soiling layer a sol-gel technique is applied. The



CCVD process is interesting from an economic point of view as the investment required is much lower than that for the CVD process applied by the glass industry. In addition the CCVD process can be used for both flat glass and a pattern surface. The sol-gel technique used is based on inorganic SiO₂ (silicate) with hydrophilic properties. This sol gel can endure temperatures up to 750°C and is very alkali and acid resistant. The hydrophilic properties enhance the durable dirt repelling properties. Water-based cleaning products are much more effective and rain water contributes to the cleaning process.

Production process

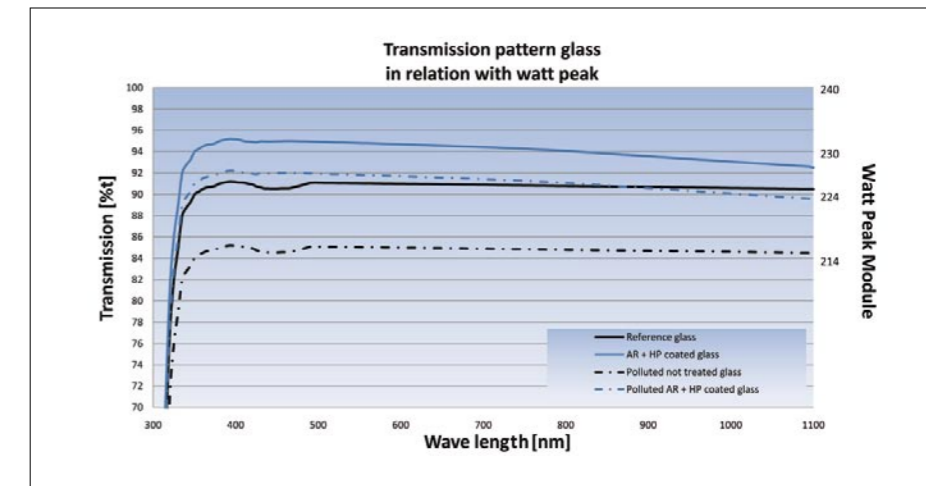
The production of Vindico PV+ is carried out using specially developed machines. They are suitable for the standard solutions of various brands to put the anti-reflective coating in place using CCVD. The substrate is cooled down and the sol-gel technique applied. Subsequently the coated glass can be processed immediately afterwards and put into operation a little while later.

Anti-bacterial

This technology can also be used for display glass (touch screens). For this purpose Ag +



Vindico PV+ Combines two technologies Creates superior results Independently tested and proven to increase Watt-peak production



Step 1: Application of CCVD* Anti-Reflective Coating
*CCVD Combustion Chemical Vapor Deposition

Vindico SiO_x forms a highly cross linked anti-reflective layer on glass

Step 2: Application of Vindico HP – Hydrophilic Technology

The most effective photovoltaic glass protection for maximizing Watt-peak output

- Two component, sol-gel technology
- Creates a SiO_x (Silicium Oxide) protective barrier - UV stable

Vindico HP has been tested and passed EN 1096, the European Standard for Glass Coatings and EN 1279 for climate testing. Vindico HP is neutral curing and biodegradable.

Care is added to Vindico PV+. This is an anti-bacterial coating developed by Vindico on the basis of silver ions. This coating is applied on the substrate by CCVD. Research according to the Japanese testing standard JIS Z 2801 shows that the coating kills bacteria. Aging tests indicate that the coating does this in a durable fashion.

Vindico PV+

Simple steps leading to astonishing results.

- Increased light transmission by up to 5 percent as result of an anti-reflective coating.
- Protection by a specific sol-gel technique
- Low soiling properties for glass, anti-reflective coatings and photovoltaic cells.
- Reduction of surface contamination and atmospheric deposits.
- Extended life-time of photovoltaic cells.
- Increased energy production.
- Short payback time.
- Wattage peak is increased by 4.85 percent of the photovoltaic module. This means that for a 50 MW power station the production is increased by 2,4 MW.
- For 850 sun hours in the Netherlands this means 10 kWh per module.

The brightest solution for increased PV productivity.

Vindico PV+

- Increases light transmission by 5%
- Reduces contamination for additional 4.7% increase
- 1% more light transmission = 0.5 gain in Watt-peak
- **Total Watt-peak gain of 4.85% per module**
- Improved performance on:
 - Standard Float Glass
 - Low Iron Glass
 - Patterned Glass
 - Mirrors

Extra information about the company

Vindico (Latin for 'protect') combines decades of knowledge of and experience in glass and coatings with innovative products. Apart from Vindico PV+, Vindico markets a number of other interesting coatings:

- Vindico Glass - protective and maintenance friendly, among other uses for blasted and etched glass and glass for shower cubicles;
- Vindico HP - protective and low soiling, among other uses for glass facades, applications with triple insulating glass, and in situations where dirt is an

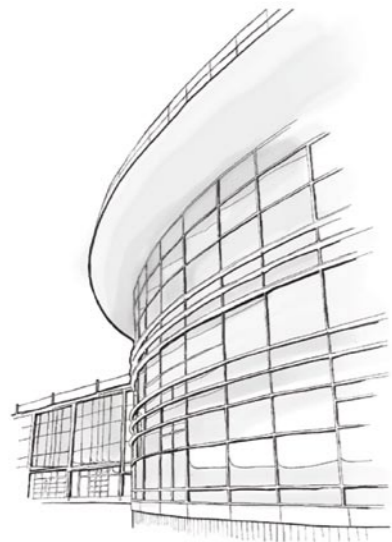
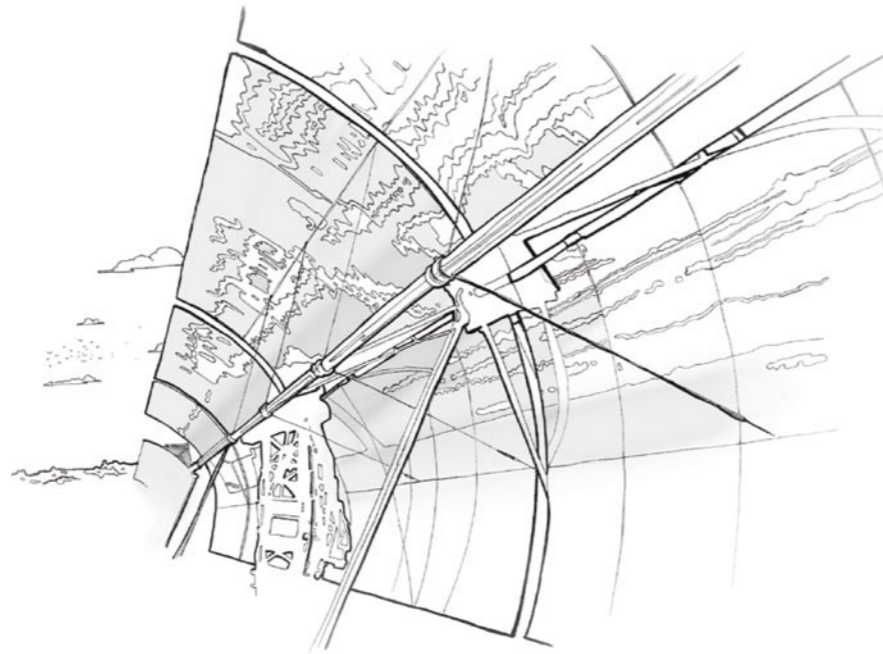
issue, such as in swimming pools, noise walls and salt water;

- Vindico Ag + Care - durable anti-bacterial coating for hospitals, laboratories, cash dispensers, kitchens, sanitary facilities, restaurants;
- Vindico Vitranova and Vitraclean – very good glass cleaning products for persistent dirt and the harmful effects of cement, concrete water and osmosis.
- Vindico design foils – unique design foils and a patented solution to make glass phosphorescent.



Product Portfolio

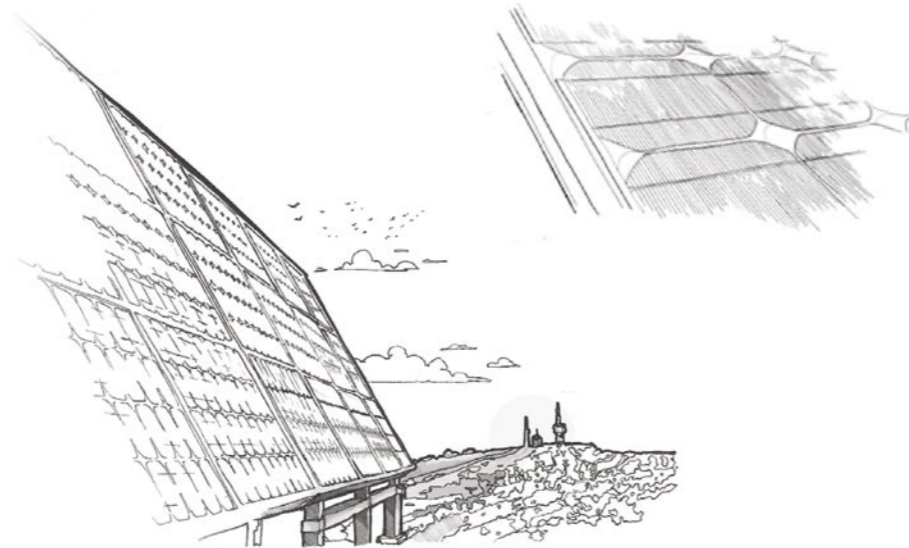
Vindico Surface Technologies manufactures and supplies chemical products for the glass industry and for glass processing companies of all sizes in the worldwide market. The company is a joint venture between Van Noordenne Glass group and P. Bastianen Holding. Vindico in Latin means “**protect**”, to make applied material more durable, less in requirement of maintenance and especially to be less of attack on the environment. Both in the application, but certainly also in the chemistry of our products.



Vindico Glass and Vindico HP Glass are special easy maintenance coatings for glass and ceramics, is neutral curing and biodegradable. Vindico HP is a SiOx hydrophilic technology, consisting of a two component chemical sol-gel that is unique to the glass market. Hydrophilic technologies are the opposite of most applied glass technologies. Due to the advantages that hydrophilic glass offers to windows, angled glass and sky lights, along with Vindico HPs compatibility with solar controlled glass, it is a natural fit for the building market.

Additionally, **Vindico HP** is particularly attractive for solar mirrors and photovoltaic panels (used to create solar energy) because a hydrophilic glass surface increases light transmission, thereby increasing the efficiency of solar glass and photovoltaic panels.

Vindico HP has a temperature permanency to 750°C and has been tested and passed EN 1096, the European Standard for Glass Coatings and EN 1279 for climate testing.



Vindico Ag+care is specifically for applications where hygiene is of the utmost importance such as hotels, hospitals, schools, sanitary rooms, laboratories and kitchens. Vindico supplies glass processing plants with chemistry, in order to apply this versatile and durable antibacterial coating on glass substrates. There is a special pyrolitic coating line for the larger processing plants. The glass is coated on-line and is resistant to scratches and cleaning agents.



Product Portfolio

Vindico Glass and Vindico HP Glass:

The neutral curing easy-maintenance coating for glass and ceramics. Used: sanitary, roofs, buildings, automotive, photovoltaic.

Vindico SiOx:

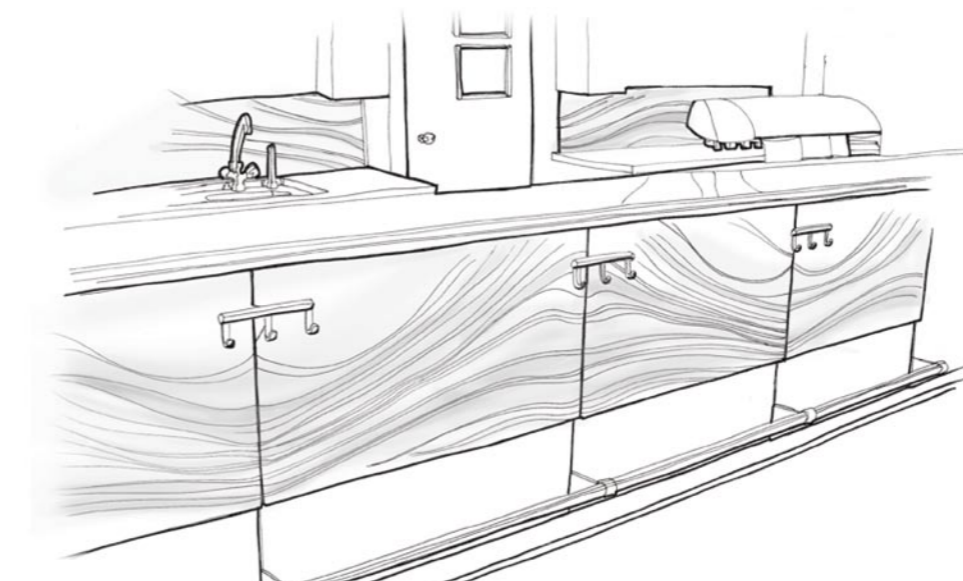
Pyrolitic apply to glass, increase adhesion on glass with paints, screen printing, powder coatings, glues and sealants.

Vindico Ag+care:

The antibacterial coating applied pyrolitic, for many different kinds of substrates, like glass, stainless steel, stone, polished granite.

Vindico Sandglass:

The environment friendly mineral foil, in several colors and designs for residential and buildings.



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