



The most efficient way of transforming sunlight into heat

TiNOX, The Energy Trap

Decisive for highest performance of a solar absorber plate is:

- **highest possible absorption** of solar radiation
- **minimum emission** of heat radiation

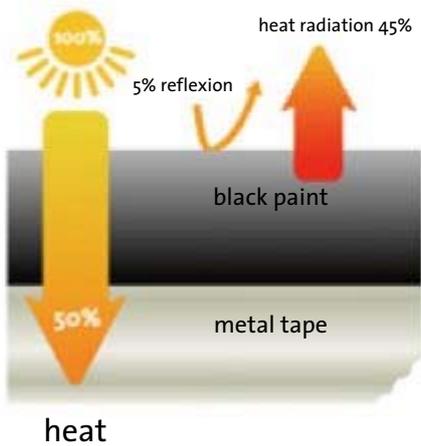
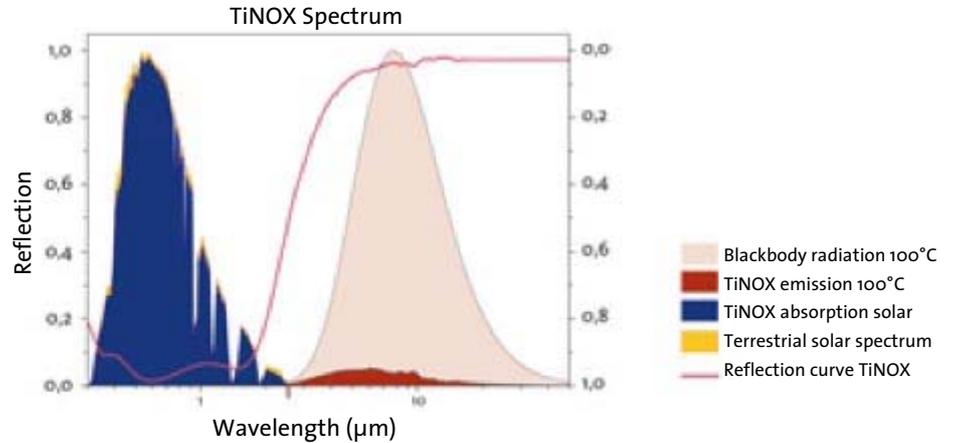
Optical Parameter TiNOX Classic

Solar absorptance

$$\alpha \gg 95 \% \pm 2 \%$$

Thermal emittance

$$\epsilon \gg 5 \% \pm 2 \%$$



Black surfaces are very good absorbers of solar radiation. The disadvantage is however that the hot absorber surface starts to emit energy in form of heat radiation (infrared radiation). Thus about 50% of the absorbed energy is lost before it can be transferred to the heat carrier fluid!

TiNOX uses the circumstance that **solar radiation** energy is irradiated in a different wave-length range ($< 2,5 \mu\text{m}$) as the **heat radiation** of a hot surface ($> 2,5 \mu\text{m}$)

The unique composition of its layer makes TiNOX a highly selective absorber, comprising the following properties:

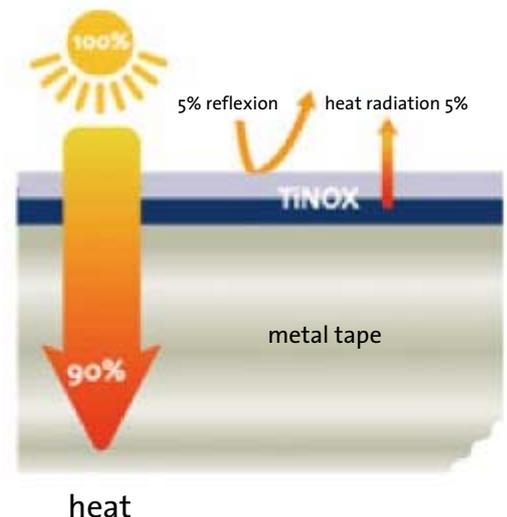
- high absorption (low reflection) in the range of solar radiation

95 % Absorption

- extremely low emission (high reflection) in the infrared

5 % Emission

All these properties enable TiNOX to convert up to 90% of the solar radiation into heat.



Layer Composition

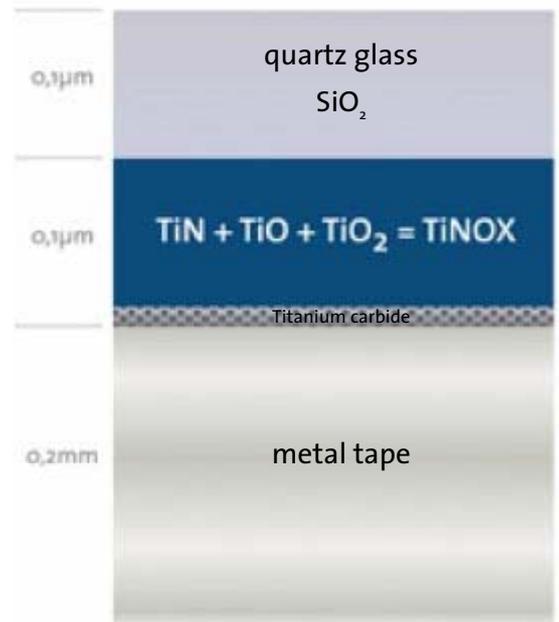
The TiNOX absorber layer is composed of several function layers:

A metal foil with good reflection and heat transfer serves as substrate.

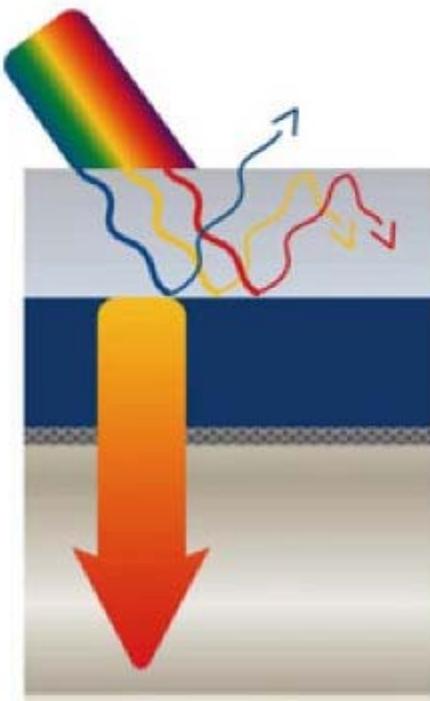
A thin titanium carbide layer serves as adhesion layer and diffusion barrier.

The absorber layer consists of a titanium composition with oxygen and nitrogen. This **patented Titaniumoxinitrid layer** is corresponding to the company name "TiNOX".

Additionally an **anti-reflex and protective layer made of quartz glass** is deposited on the absorber layer. The absorption of solar radiation is still more improved by the coeval minimization of the surface reflection.



Appearance of the TiNOX colour:



The TiNOX colour is formed by a multiple reflection of the incident light within the quartz glass layer.

Depending on the thickness of the anti-reflex quartz glass layer specific wave-lengths will be transferred into heat, and a small portion of wave lengths will be reflected. The range of wave lengths of reflected radiation determines the colour appearance.

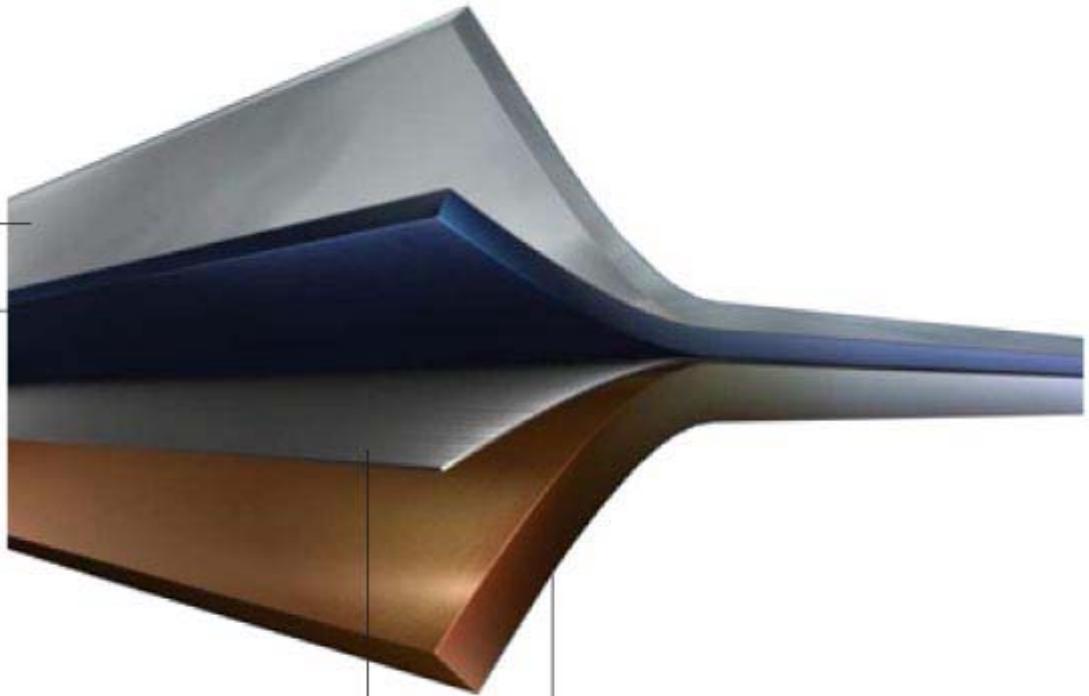
In the case of TiNOX classic only small quantities of the blue light are reflected resulting in blue appearance of the material.

It is a sole matter of colours of light, which are not determined by the basic colour of the material.

Benefits of the TiNOX Components

Quartz glass

chemically and physically extremely resistant
There is almost no acid which can solubilise quartz.
Thermal resistance (It only melts at 1550°C)
Furthermore it is very hard and gives therefore optimum protection against scratches



Titanium

extremely hard
low level of toxicity
high corrosion resistance
resistant against highest temperatures

Titanium carbide

Diffusion barrier
Adhesion layer

Copper

highest heat conductivity
easy to process
recyclable to almost 100 %.

does not cause any problems of corrosion inside the collector
copper is a very good reflector in the infrared wave range – vital for realisation of low emission values

Environment and Nature

The components of the TiNOX layer are harmless for the human organism and for the environment.

TiNOX coating is 100% recyclable. The metal of the absorbers is completely re-usable.

The consumption of raw materials for the TiNOX coating is extremely small and thus preserving resources. 1 m² TiNOX coating needs

Titanium 1 g/m²

Quartz 0,9 g/m²

The coating of 1 m² of TiNOX material requires 0,87 kWh.

1 m² TiNOX generates more than 500 kWh per year,

hence the energy demand for the coating, is **amortized within one single “sunny”-day.**



Certified Performance and Durability

The outstanding properties of TiNOX are certified by independent testing Institutes.

These certificates are related to the optical properties solar absorptance α and thermal emittance ϵ as well as temperature stability and climate resistance.

Guarantee of a stable TiNOX performance:



To prove the long lasting performance of TiNOX absorbers, the “**task X**”-test (ISO draft proposal CD 12 952.2) was developed in cooperation with reputable research institutes.

It simulates temperature and ambient influences on the selective coating during long term operation.

Coatings examined by “**task X**” guarantee ,after a simulated time of 25 years, an efficiency of 95 % compared to the initial properties. TiNOX has been certified “**task X**” by :

Institut für Thermodynamik und Wärmetechnik, Stuttgart (ITW)

Fraunhofer Institut ISH in Freiburg (ISE)

Institut für Solartechnik, Hochschule Rapperswill (SPF)

Swedish National Testing and Research Institute



Your partner for highly selective coatings

www.tinox.com

TiNOX GmbH Development and Production solar Energy Systems
Triebstraße 3 D-80993 Munich, Germany
Tel.: +49 (0) 89 14 72 96 0
Fax: +49 (0) 89 14 72 96 72
info@tinox.com