Nanocoating and Testing; A step towards the improvement of CSP reflectors for less intensive maintenance both in terms of labor and water.

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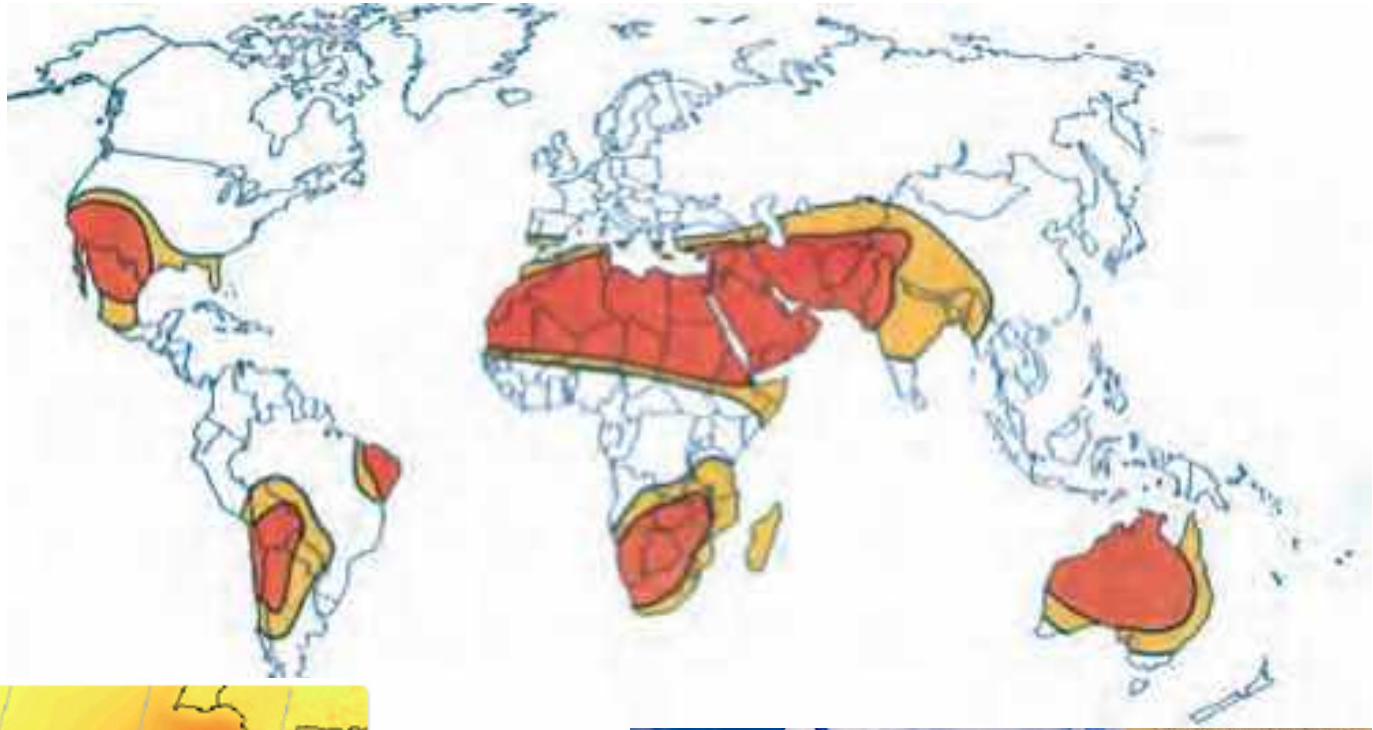
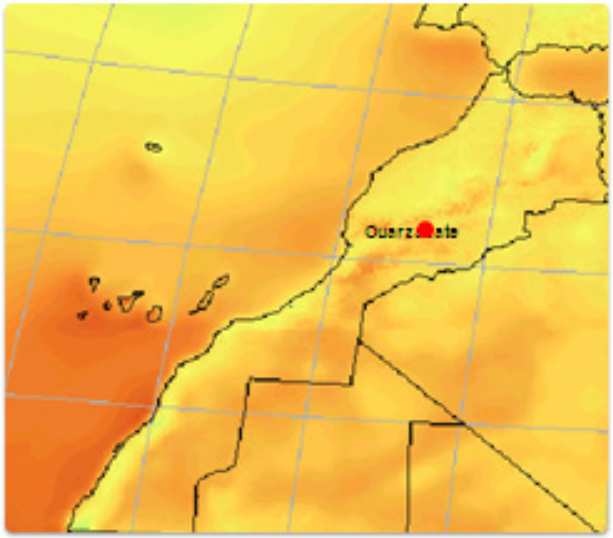
CSP Technology





SPECULAR REFLECTANCE

- The collector mirror should be characterize by a high the specular reflectance (SR).
- SR is the degree to which a mirror is capable of transferring directed radiation to a target receiver surface.
- Reflectance difference of only a few percent strongly influence power plant efficiency and electricity cost.
- High specular reflectivity of the solar radiation has to be maintained over a long lifetime.

Problematic

- Generally, Potential areas to construction of large CSP plants are large and flat areas with high solar radiation factor.

- Deserts represent the best alternative for these installations causing a serious accumulation problem of both dust ad moister and a lot of limitations for the optimum functioning of CSP plant.

- Therefore, CSP plants need intensive maintenance both in terms of labor and water.

Purpose of the Project:

Mirrors should have a high specular reflectance, a long life in an aggressive atmosphere and an accessible price.

Improve the quality of Concentrated Solar Power plants by developing new coating materials that are lower in weight, more durable, energy efficient and more cost-effective for less maintenance and higher efficiency of the mirrors.

Literature review

- Current reflectors have SR of 93 to 94% with an expected life time of 20 to 25 years without excessive corrosion and UV degradation.

- The most commonly used reflectors are:

  - **Silver coated float glass** or **tempered float glass**
  - **Aluminum sheets coated** with highly reflecting layers of Aluminum or Silver.
  - High reflectance foil made of **multiple layers of polymers** because of its light weight and its high malleability.

- Any collector that is not protected and that is exposed outdoor, there optical characteristic will depredate in couple of years.

- It is very important to use Nanocoating of reflectors to maintain their durability without altering their specular reflectance is a promising option.

- Almanza et al suggested $\mathbf{SiO_2}$ or $\mathbf{Al_2O_3}$ as an alternative for nanocoating of aluminum first surface mirrors and were able to decrease considerably abrasion and help to obtain a better resistance to corrosion.

Research Strategy

In order to realize self-cleaning material surfaces there are two principal ways:

The development of

- Super-hydrophobic or super-hydrophilic materials. By transferring the microstructure of selected plant surfaces (Lotus effect).

- Super-hydrophilic materials may be developed by coating glass, ceramic tiles or plastics with the semiconducting photocatalyst titanium dioxide (TiO2)

Lotus Effect

- The microrough surfaces show contact angles higher than 130°.
- This means, that the adhesion of water, as well as particles is extremely reduced. Water which contacts such surfaces will be immediately contracted to droplets.
- The particles of contaminants adhere to the droplet surfaces and are removed from the rough surface when the droplets roll of.

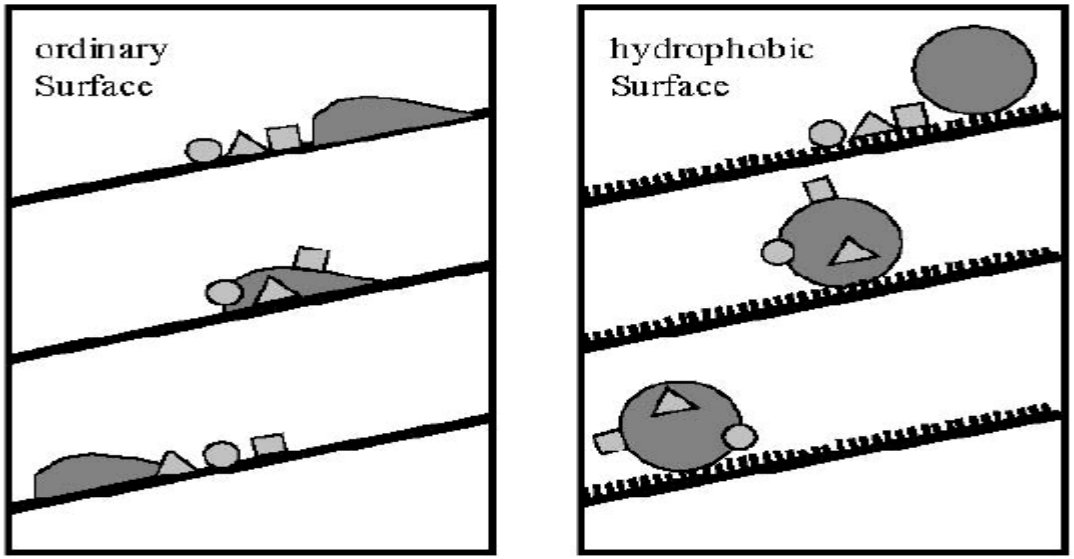


Fig.1 Lotus effect

PHOTOCATALYSIS

- A heterogeneous photocatalytic system consists of semiconductor particles (photocatalyst) which are in close contact with a liquid or gaseous reaction medium. Exposing the catalyst to light excited states are generated which are able to initiate subsequent processes like redox reactions and molecular transformations.

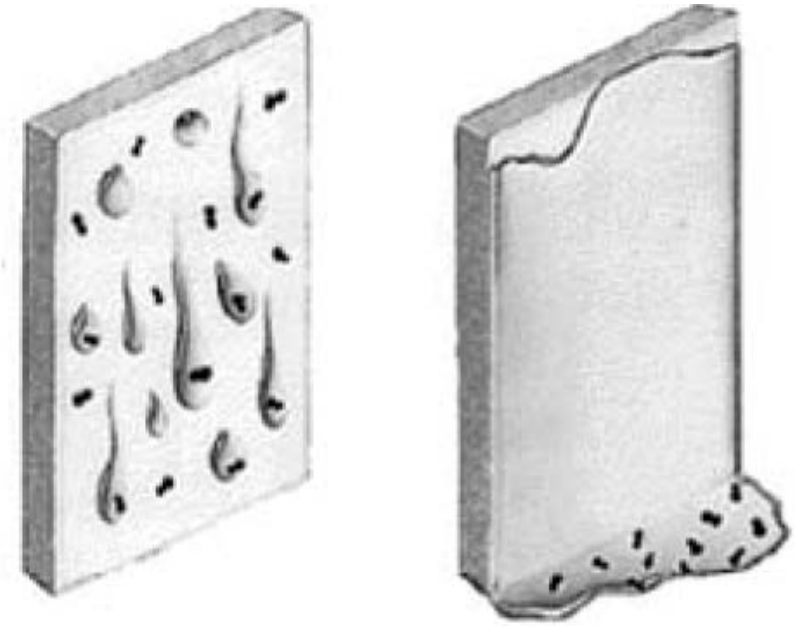


Fig. 6: Super-hydrophilicity

Research Steps

- A laboratory research of the surface free energy of the reflectors and of the interaction with water, salt and dust to conclude about the ability of these surfaces to attract or repel using a Goniometer.
- Compute the contact angle θ between a water droplet on a given surface (repeal (180°) or attract (0°)).
- Investigate different materials suggested.
- Collection of the SR using a spectrophotometer to determine the loss in reflector's radiation due to the dust or moisture formation is planned.
- Come up with our own nanocoating materials.

Funding and collaboration

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