

International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

Balapur P.O., Hyderabad – 500005, Telangana, India



Solar Selective Coatings for Stainless Steel and Aluminium Substrates

Overview

Solar thermal devices convert solar radiation into heat, which is subsequently converted into electricity using a typical thermal power plant. Functional coatings on components of a solar thermal device, especially in the heat collection element (HCE), can substantially improve the efficiency of the solar to thermal energy conversion. The absorber tube in the HCE has a solar selective coating (SSC) to realize high solar to thermal conversion efficiency. Any improvement in the solar selective property directly results in reduced cost of solar power by bringing down the cost of thermal energy storage. In the past, hexavalent chrome-based coatings were used as SSC. However, due to the toxic and carcinogenic nature of hexavalent chrome, its use has been strictly banned across the world. ARCI has developed a hexavalent chrome-free, non-toxic environmental friendly solar selective coating that can exhibit optical properties better than the chrome-based coatings.

Key Features

- 94 ± 1 % absorbance in 300-1500 nm range
- 14 ± 1 % Thermal IR emittance
- Withstood 20 cycles of thermal cycling at 350°C
- Withstood 80 h of salt spray test as per ASTM B117
- Non-toxic and environmental friendly

Potential Applications

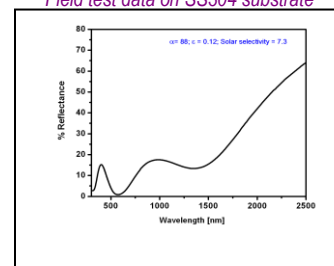
- Solar selective coatings on absorber tubes of Concentrated Solar Power plant (Non-evacuated up to 250 deg C and evacuated up to 400 deg C)
- Solar selective coatings on metal tubes for water heating applications (up to 100 deg C)

Intellectual Property Development Indices (IPDI)

- Performance and stability validated at laboratory scale
- Scale-up and prototype testing completed

Coating composition	Chrome based coating by electrodeposition	ARCI sol-gel solar selective coating
Average DNI (W/m ²)	680	719
Optical efficiency (%)	60	60
Heat loss at 200°C, (W/m)	96	76

Field test data on SS304 substrate



UV-Vis-NIR spectrum of sol-gel based solar selective coating

Status	1	2	3	4	5	6	7	8	9	10
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Major Patents / Publications

1. An improved composition for solar selective coatings on metallic surfaces and a process for its preparation and a process for coating using the compositions, Indian patent application number 3324/DEL/2011 dtd 22-11-11.
2. R. Subasri, K.R.C. Soma Raju, D.S. Reddy, Neha Y. Hebalkar, G. Padmanabham, Sol-gel Derived Solar Selective Coatings on SS 321 Substrates for Solar Thermal Applications, Thin Solid Films 598 (2015) 46-53.
3. Priya Anish Mathews, K.R.C. Soma Raju, Sanjay Bhardwaj and R. Subasri (2013): Sol-Gel Functional Coatings for Solar Thermal Applications: A Review of Recent Patent Literature, Recent Patents on Materials Science 6, 195-213.

Centre for Sol-Gel Coatings (CSOL)

ARCI, Balapur PO., Hyderabad 500005, Telangana, India

Tel : +91 40 24452465; Fax : +91 40 24442699

Email: subasri [at] arci [dot] res [dot] in / royjohnson [at] arci [dot] res [dot] in