**Modification of Spaceflight Radiator Coating Pigments by Atomic Layer Deposition for Thermal Applications**

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The optical and physical properties of spacecraft radiator coatings are dictated by orbital environmental conditions. For example, coatings must adequately dissipate charge buildup when orbital conditions, such as polar, geostationary or gravity neutral, result in surface charging. Current dissipation techniques include depositing a layer of ITO (indium tin oxide) on the radiator surface in a high temperature process. The application of these enhanced coatings must be such that the properties in question are tailored to mission-specific requirements.

The deposition of thin films by atomic layer deposition is a natural technological fit for manufacturing spacecraft components where weight, conformality, processing temperature, and material selection are all at a premium. Indium oxide (IO) and indium tin oxide (ITO) are widely used in optoelectronics applications as a high quality transparent conducting oxide layer [1]. In this work, we present the thickness-dependent electrical and optical properties of IO thin-films synthesized by ALD with the aim of finding the optimum condition for coating a variety of substrates from Si(100) wafers, glass slides, and especially radiator pigments [2]. Radiators are given surface finishes with high IR emittance to maximize heat rejection and low solar absorptance to limit heat loads from the sun. The surface finish is typically a white paint composed of nano/micron particle sized pigments with a silicate binder. It is the encapsulation of these particles that dictate the charge bleed off properties of the finished coating. Trimethylindium and ozone were used as precursors for IO, while a tetrakis(dimethylamino)tin(IV) source was used for Sn doping to produce ITO. As-deposited IO films prepared at 140°C resulted in a growth per cycle of 0.46 Å/cycle and relatively low film resistivity.

For the case of ITO thin-films, an ALD process supercycle consisting of 1 Sn + 19 In cycles was shown to provide the optimum level of Sn doping corresponding to the 10 wt.% widely reported in the literature. By using the inherent advantage of ALD in coating high aspect ratio geometries conformally, modification of these pigments can be accomplished during coating application preprocessing. The preprocessing is rendered directly on the dry pigment/particle before binding and not on the finished coated radiator geometry thus saving reactor volume.

Samples of our coating were recently launched into space and are currently onboard the International Space Station (ISS) as part of the one-year MISSE-10 materials test mission where the IO coated pigments are exposed to the harsh environment of space.

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