Topical Symposium on Sustainable Surface Engineering
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Solar Thermal Conversion - TS3 Poster Session

TS3-ThP-1 Tailoring the Structural, Optical and Electrical Properties in Perovskite Nickelates Through the Tilt Control of $Nd_{1-x}Sm_xNiO_3$ Thin Films, ***Zil Fernández-Gutiérrez (zil.fernandez-gutierrez@univ-lorraine.fr)**, T. Easwarakhanthan, S. Bruyère, D. Pilloud, S. Barrat, F. Capon,* Institut Jean Lamour - Université de Lorraine, France

Rare-earth nickelates (*R*NiO_3) are functional oxides with a vast landscape of properties, with the metal-insulator transition (MIT) being the most attractive one. This latter can be modified by varying the *rare-earth* atomic composition ($R'_{1-x}R_xNiO_3$) and the consequent tilt of the crystalline structure. However, obtaining solid solutions of this perovskite family is even more complex due to the specific composition control and the bottleneck that has been their synthesis over the years. Even so, this work aims to customize the thermochromic behavior of the layers to enhance infrared thermal regulation in solar collectors between 60 and 80 °C. Therefore, $Nd_{1-x}Sm_xNiO_3$ thin films were synthesized using reactive magnetron sputtering and air-annealing. Comprehensive XRD and TEM analysis confirms the efficient synthesis of various crystallized nickelates within the $SmNiO_3$ to $NdNiO_3$ range. This methodology facilitates the tunability of MIT temperatures between -80 and 120 °C as Sm atoms progressively replace Nd atoms. Optical performance, assessed through FTIR spectroscopy, aligns with literature-reported MIT temperatures. Additionally, a detailed examination of the structural, electrical, and electronic properties of the $Nd_{0.2}Sm_{0.8}NiO_3$ combination is presented. Lastly, ellipsometry measurements reveal a metal-like to dielectric-like phase change in the imaginary part of the dielectric function with photon energy, while the real part indicates oxidation in the upper film volume. These findings advance the understanding of $Nd_{1-x}Sm_xNiO_3$ nickelate thin films and their potential applications in thermochromic devices for solar energy utilization.

TS3-ThP-2 Trigeneration Plants Based on Solar Selective Surfaces of Carbon, ***Jose L. Endrino Armenteros (jlendrino@uloyola.es)**, E. Valbuena Niño,* Universidad Loyola Andalucia, Spain*; F. Montero-Chacón,* Universidad Loyola Andalucía, Spain*; A. Sandoval, M. Zurita,* Universidad Loyola Andalucia, Spain

The SSC material is one of the major components in solar-driven trigeneration technologies. The optical properties determine the efficiency of the energy conversion from the concentrated sun irradiation. Solar receivers are usually maintained under vacuum as to limit convective thermal losses, the absorber coating is typically designed to operate without oxidative atmosphere. The development of a solar receiver, able to operate under air, is a challenge to reduce some of the costs. It is also a way to lower the complexity of existing linear CSP technologies. Although standard solar troughs receivers operate inside an annulus with a pressure of less than 10-4 mbar, the proposed trigeneration technology will require the SSC material to operate in an oxidizing (ambient air) atmosphere and avoid critical troubleshoots due to accidental glass breakage and an unexpected vacuum loss.

Solar absorber layers based on nanocomposite materials (a-C:MeC) are here proposed. These nanocomposites are suitable candidates for medium-temperature solar absorber applications. Pure a-C thin films in combination with group 4, 5, and 6 transition metals form a number of exceptionally stable interstitial carbides. These carbides are characterized by high melting points, high thermal and electrical conductivity, and high reflectivity in the entire UV-Vis-IR spectral range. The presence of these carbides stabilizes the nanocomposite microstructure at this range of temperatures. Different microstructures and morphologies nanocomposite layers are here explored in combination with the Infrared (IR) layer made of titanium nitride (TiN) and a defect free alumina antireflective (AR) layer.

In addition, a simulation platform which we can run several scenarios that include, but are not limited to, hospitals, supermarkets, schools, residences, etc. will provide information on the trigeneration plant (i.e., heating, cooling, and electricity loads) for given scenarios using carbon-based coating materials.

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