ST-P012

Performance Analysis of Double-Glazed Flat Plate Solar Collector with Cu-based Solar Thermal Absorber Surfaces

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In this work, we experimentally investigated the solar absorption performance of Cu-based scalable nanostructured surfaces and compared their performance with the conventional TiNOX. We fabricated Cu-based nanostructured surfaces with a controlled chemical oxidation process applicable to a large area or complex geometry. We optimized the process parameters including the chemical compounds, dipping time and process temperature. We conducted both lab-scale and outdoor experiments to characterize the conversion efficiency of each absorber surfaces with single and double glazing setup. Lab-scale experiment was conducted with 50 mm x 50 mm absorber sample with 1-sun condition (1kW/m2) using a solar simulator (PEC-L01) with measuring the temperature at the absorber plate, cover glass, air gap and ambient. From the lab-scale experiment, we obtained ~91℃ and 94℃ for CuO and TiNOX surfaces after 1 hr of solar illumination at single glazing, respectively. To measure the absorber performance at actual operating condition, outdoor experiment was also conducted using 110 mm x 110 mm absorber sample. We measured the solar flux with thermopile detector (919P-040-50). From outdoor experiment, we observed ~123℃ and 131℃ for CuO and TiNOX with 0.6 kW/m2 insolation at double glazing, respectively. We showed that the suggested nanostructured CuO solar absorber has near-equivalent collection efficiency compared with the state-of-the-art TiNOX surfaces even with much simpler manufacturing process that does not require an expensive equipment.

Keywords: Solar Absorber, CuO, TiNOX, Scalable, Absorptivity, Emissivity

ST-P013

Superhydrophobic Surfaces for condensation by using spray coating method

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Water repellent surfaces may enhance the condensation by efficiently removing the condensed droplets. However, such surfaces may lose their original performance as they are exposed to external mechanical stresses. In this work, we fabricated spray-coated mechanically robust superhydrophobic surfaces using treated titanium dioxide (Type 1) or silica particles (Type 2). Then we compared the mechanical robustness of such surfaces with the silane-coated superhydrophobic surface and PEEK coated surface using a controlled-sand blasting method. The results show that the spray-coated samples can maintain the same level of the contact angle hysteresis than silane-coated superhydorphobic surface after sand blasting at 2 bar. The spray-coating method was applied to the tube type condenser and the condensation behaviors were observed within the environmental chamber with controlled pressure, humidity and non-condensable gas. Previously-reported droplet jumping was observed in the early stage of the condensation event, but soon the droplet jumping stopped and only dropwise condensation was observed since the condensed droplets were pinned on the cracks at spray-coated surfaces. The static contact angle decreases from 158.0° to 133.2°, and hysteresis increases from 3.0° to 23.5° when active condensation occurs on such surfaces. This work suggests the benefits and limitation of spray-coated superhydrophobic condensers and help develop advanced condensers for practical use.

Keywords: Superhydrophobic, Condensation, Spray coating, Robust, Adhesion