Polymer Nanocoatings With Enhanced Self-Cleaning and Icephobic Properties

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Abstract : The build-up and accumulation of dirt, ice, and snow on structural elements and vehicles is an unfavorable phenomenon, leading to economic losses and often also posing a threat to people. This problem occurs wherever the use of polymer coatings has become a standard, among others in photovoltaic farms, aviation, wind energy, and civil engineering. The accumulated pollution on the photovoltaic modules can reduce their efficiency by several percent, and snow stops power production. Accumulated ice on the blades of wind turbines or the wings of airplanes and drones disrupts the airflow by changing their shape, leading to increased drag and reduced efficiency. This results in costly maintenance and repairs. The goal of the work is to reduce or completely eliminate the accumulation of dirt, snow, and ice build-up on polymer coatings by achieving self-cleaning and icephobic properties. It is done by the use of a multi-step surface modification of the polymer nanocoatings. For this purpose, two methods of surface structuring and the preceding volumetric modification of the chemical composition with proprietary organosilicon compounds and/or mineral additives were used. To characterize the surface topography of the modified coatings, light profilometry was utilized. Measurements of the wettability parameters (static contact angle and contact angle hysteresis) on the investigated surfaces allowed to identify their wetting behavior and determine relation between hydrophobic and anti-icing properties. Ice adhesion strength was measured to assess coatings' anti-icing behavior.

Keywords : anti-icing properties, self-cleaning, polymer coatings, icephobic coatings
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