Enhancing glass surface hydrophobicity: the role of Perfluorooctyltriethoxysilane in advanced surface modification

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Abstract

This study presents a novel approach to fabricate self-cleaning, superhydrophobic coatings on glass surfaces and photovoltaic cells. Using a cost-effective spray-coating technique, superhydrophobic glass surfaces were developed incorporating modified SiO_2 nanoparticles (NPs), synthesized via a simple sol–gel method. Silylating agents, Poly(dimethylsiloxane) (PDMS) and Perfluorooctyltriethoxysilane (PFOS), were used for the modification, resulting in enhanced surface roughness and hydrophobicity. The study extensively characterizes the analytical techniques such as Fourier transform infrared spectroscopy (FT-IR), atomic force microscopy (AFM), transmission electron microscopy (TEM), scanning electron microscopy (SEM), and contact angle measurements. Modified NPs with PFOS showed a significant improvement in hydrophobic properties, with water contact angles of 144.73° and sliding angles of 5°. The stability of these surfaces under various pH conditions was also evaluated. This research contributes valuable insights into the development of self-cleaning coatings for glass and photovoltaic cells, demonstrating the potential of superhydrophobic surfaces in practical applications.