Development of an Innovative Anti-dust Acrylic/SiO2 Coating for Improved Solar Cell Efficiency

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Solar panels are considered an efficient and sustainable energy solution; however their performance and longevity are increasingly compromised by dust accumulation. Previous studies have indicated that this problem reduces efficiency by approximately 60% due to dust accumulation. Numerous coatings have been formulated to alleviate the impact of dust accumulation; however, the majority have faced challenges regarding adhesiveness, light transmission, hydrophobicity, and cost-effectiveness. This study aimed to develop an innovative acrylic-SiO2 composite coating that repels dust to improve solar cell efficiency. SiO2 was synthesized via the sol-gel method and then functionalized using PDMS and TFPS to extend the hydrophobic profile. After that, acrylic was subsumed into the solution through sonication and stirring. The transparency of the coating was evaluated using UV-Vis testing while the surface roughness was measured using optical profilometry, and lastly, the surface property was measured using contact angle. The results showed that the coating exhibited an 89.75% light transmission rate. The surface roughness was 2.5 microns, demonstrating micro-surface roughness. The coating exhibited near-superhydrophobicity at exactly 135°. As dust accumulation continues to deduct the efficiency of solar panels, the need for an effective anti-dust coating becomes dire in increasing renewable energy output. This research offers a reliable solution to enhance solar efficiency, driving the transition toward a more sustainable future.

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