Turning Waste Styrofoam Into Water-Repellent Coatings

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Hydrophobic (or water-repellent) coatings are of particular interest because of their broad relevance to surface protection, self-cleaning, and environmental durability. Here, we focus on transforming waste expanded polystyrene (styrofoam) into hydrophobic coatings by integrating silica particles. Despite extensive studies on hydrophobic materials, scalable and low-cost strategies directly upcycling styrofoam waste into robust coatings without complex chemical modification remain limited. Herein, we show that waste styrofoam, when combined with silica and processed through a simple coating application technique, forms surfaces with hierarchical micro–nano surface roughness exhibiting hydrophobicity (with contact angles > 90º). Morphological analysis will reveal that silica particles induce controlled surface texturing, while the polystyrene matrix provides intrinsic hydrophobicity and mechanical continuity. The findings here will demonstrate a viable route for converting styrofoam waste into high-performance, water-repellent coatings with immediate relevance to protective surfaces, packaging, and others. More broadly, this work hopes to advance sustainable materials design by coupling waste valorization with functional surface engineering and opens opportunities for scalable deployment in environmental and industrial applications.

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