

Development of Excellent Water-Repellent Coatings for Metallic and Ceramic Surfaces

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Abstract : One of the most fascinating properties of various insects and plant surfaces in nature is their water-repellent (superhydrophobicity) capability. The nature offers new insights to learn and replicate the same in designing artificial superhydrophobic structures for a wide range of applications such as micro-fluidics, micro-electronics, textiles, self-cleaning surfaces, anti-corrosion, anti-fingerprint, oil/water separation, etc. In general, artificial superhydrophobic surfaces are synthesized by creating roughness and then treating the surface with low surface energy materials. In this work, various superhydrophobic coatings on metallic surfaces (aluminum, steel, copper, steel mesh) were synthesized by chemical etching process using different etchants and fatty acid. Also, SiO₂ nano/micro-particles embedded polyethylene, polystyrene, and poly(methyl methacrylate) superhydrophobic coatings were synthesized on glass substrates. Also, the effect of process parameters such as etching time, etchant concentration, and particle concentration on wettability was studied. To know the applications of the coatings, surface morphology, contact angle, self-cleaning, corrosion-resistance, and water-repellent characteristics were investigated at various conditions. Furthermore, durabilities of coatings were also studied by performing thermal, ultra-violet, and mechanical stability tests. The surface morphology confirms the creation of rough microstructures by chemical etching or by embedding particles, and the contact angle measurements reveal the superhydrophobic nature. Experimentally it is found that the coatings have excellent self-cleaning, anti-corrosion and water-repellent nature. These coatings also withstand mechanical disturbances such surface bending, adhesive peeling, and abrasion. Coatings are also found to be thermal and ultra-violet stable. Additionally, coatings are also reproducible. Hence aforesaid durable superhydrophobic surfaces have many potential industrial applications.

Keywords : superhydrophobic, water-repellent, anti-corrosion, self-cleaning

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