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Water-Repellent Coating Based on Thermoplastic Polyurethane, Silica Nanoparticles and Graphene Nanoplatelets

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Abstract : This work describes a layer-by-layer spraying method to produce a non-wetting coating, based on thermoplastic polyurethane (TPU) and silica nanoparticles (Si-NPs). The main purpose of this work was to transform a hydrophilic polymer to superhydrophobic coating. The contact angle of pure TPU was measured about 77˚ ± 2, and water droplets did not roll away upon tilting even at 90°. But after applying a layer of Si-NPs on top of this, not only the contact angle increased to 165˚ ± 2, but also water droplets can roll away even below 5˚ tilting. The most important restriction in this study was the weak interfacial adhesion between polymer and nanoparticles, which had a bad effect on durability of the coatings. To overcome this problem, we used a very thin layer of graphene nanoplatelets (GNPs) as an interlayer between TPU and Si-NPs layers, followed by thermal treatment at 150˚C. The sample's morphology and topography were characterized by scanning electron microscopy (SEM), EDX analysis and atomic force microscopy (AFM). It was observed that Si-NPs embedded into the polymer phase in the presence of GNPs layer. It is probably because of the high surface area and considerable thermal conductivity of the graphene platelets. The contact angle value for the sample containing graphene decreased a little bit respected to the coating without graphene and reached to 156.4˚ ± 2, due to the depletion of the surface roughness. The durability of the coatings against abrasion was evaluated by Taber® abrasion test, and it was observed that superhydrophobicity of the coatings remains for a longer time, in the presence of GNPs layer. Due to the simple fabrication method and good durability of the coating, this coating can be used as a durable superhydrophobic coating for metals and can be produced in large scale.

Keywords : graphene, silica nanoparticles, superhydrophobicity, thermoplastic polyurethane
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