Composite coatings with structured roughness for water repellant applications

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A simple and efficient approach for preparation of hybrid nanoparticle-polymer films with structured roughness for water-repellent applications was developed. The coatings were applied using an airbrush, in a layer-by-layer configuration, hybrid polymeric matrix first, followed by the nanoparticle dispersion. Various polymeric matrices were tested, namely raw chitosan or chitosan bearing surface vinyl groups, subsequently crosslinked with ethylene glycol dimethacrylate using either thermal or UV initiation.
The micro-scale surface protuberances were created by iron oxide nanoparticles that are capable of magnetic self-assembling during the curing stage. The magnetite nanoparticles were prepared by mild oxidation of ferrous ions in alkaline solution, followed by functionalization using oleic acid, sodium oleate, or non-ionic surfactant mixtures with various hydrophilic to lipophilic balance values, or by amination with (3-aminopropyl) triethoxysilane. The third component, pre-hydrolyzed/precondensed sol–gel solution of hexadecyltrimethoxy silane, was incorporated both into the matrix and the nanoparticle suspension, in order to promote the interfacial adhesion and to improve the properties of composites. Hybrid nanoparticle-polymer films prepared by spraying were deposited and cured by drying on glass slides. The water contact angle measurements evidenced both hydrophobic and superhydrophobic surfaces when using chitosan-silane-magnetite derivatives hybrid films. Future investigations will focus on controlling the layer thickness and the surface morphology.