coatings

Editorial

Water- and Oil-Repellent Surfaces

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In the last two decades, materials of extreme wetting properties have received significant attention, as they offer new perspectives providing numerous potential applications. Water- and oil-repellent surfaces can be used, for instance, in the automobile, microelectronics, textile and biomedical industries, in the protection and preservation of constructions, buildings and cultural heritage and in several other applications relevant to self-cleaning, biocide treatments, oil–water separation and anti-corrosion, just to name a few.

The papers included in the Special Issue "Water- and Oil-Repellent Surfaces" present innovative production methods of advanced materials with extreme wetting properties which are designed to serve some of the abovementioned applications. Moreover, the papers explore the scientific principles behind these advanced materials and discuss their applications to different areas of coating technology. In particular:

Kapica et al. developed a two-step plasma modification process to create an artificial superhydrophobic surface on goose down. Two types of precursors for plasma-enhanced chemical vapor deposition (PECVD) were applied. The effects of the precursors on the wetting properties, surface morphology and chemical structure on the produced surfaces were investigated using a variety of different microscopic and spectroscopic techniques. The surface of the goose down became superhydrophobic after the plasma process and revealed a very high resistance to fungi.

Ma and Liu studied the effect of sodium methyl silicate (SMS) on the capillary water rise in silt. It was shown that SMS can effectively inhibit the rise of capillary water in silt: the maximum height of capillary rise can be reduced to 0 cm, provided that an appropriate concentration of SMS is used. SMS forms a water-repellent membrane by reacting with water and carbon dioxide, resulting in a large (120°) contact angle of water drops on treated silt. The membrane reduces the apparent surface energy of the treated silt and, moreover, it is combined with small particles of the soil, thus affecting the pores and inhibiting the rise of capillary water.

Chatzigrigoriou et al. produced calcium hydroxide nanoparticles ($Ca(OH)_2$) which were dispersed in an aqueous emulsion of silanes/siloxanes. The dispersion was deposited on marble surfaces, which obtained water repellent properties. Moreover, it was shown that the siloxane + $Ca(OH)_2$ composite coating offers good protection against water penetration by capillarity and has a small effect on the aesthetic appearance of marble. Because $Ca(OH)_2$ is chemically compatible with limestone-like rocks, which are the most common stones found in buildings and objects of tcultural heritage, the produced composite coatings have the potential to be used for conservation purposes.

Lettieri et al. produced a highly hydrophobic and oleophobic nano-filled coating using fluorine resin and silica (SiO_2) nanoparticles. The anti-graffiti performance of the coating on calcareous stones, which have been used in buildings of cultural heritage, was evaluated. For comparison, two commercial coatings were included. It was found that the protective coatings facilitated the removal of an acrylic spray paint, but high oleophobicity or paint repellence did not guarantee a complete cleaning. The stain from a felt-tip marker was difficult to remove. The cleaning with a solvent promoted the movement of the applied polymers and paint in the porous structure of the stone substrate.

Lei et al. produced a superhydrophobic copper oxide (Cu_2O) mesh through a facile chemical reaction between copper mesh and hydrogen peroxide solution without any low surface reagents treatment. The new material was designed to be used for oil–water separation. With the advantages of simple operation, short reaction time, and low cost, the produced superhydrophobic mesh showed excellent oil–water selectivity for many organic solvents. Furthermore, the Cu_2O mesh showed excellent durability, as it can be reused for oil–water separation with a high separation ability of above 95%.

Kim et al. prepared functionalized silica (SiO_2) nanoparticle dispersions which were sprayed onto acrylate-polyurethane (PU) on solid substrates. PU played the role of the binder between the thin SiO_2 layer and the substrate. The influence of the SiO_2/PU ratio on the wetting properties and the robustness of the developed surface was systematically analyzed. The best SiO_2/PU ratio to achieve durable superhydrophobicity was found to vary within 0.9 and 1.2. The evolution of the morphology of the surface with respect to the wetting properties was investigated in detail using different weight ratios of the particles to the binder. Moreover, it was concluded that the binder plays a key role in controlling the surface roughness and superhydrophobicity through the capillary mechanism.

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