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Fabrication of Superhydrophobic Galvanized Steel by Sintering Zinc Nanopowder

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Abstract : Galvanized steel is one of the widespread metallic materials used in industry. It consists on a iron-based alloy (steel) coated with a layer of zinc with variable thickness. The zinc is aimed to prevent the inner steel from corrosion and staining. Its production is cheaper than the stainless steel and this is the reason why it is employed in the construction of materials with large dimensions in aeronautics, urban/ industrial edification or ski-resorts. In all these applications, turning the natural hydrophilicity of the metal surface into superhydrophobicity is particularly interesting and would open a wide variety of additional functionalities. However, producing a superhydrophobic surface on galvanized steel may be a very difficult task. Superhydrophobic surfaces are characterized by a specific surface texture which is reached either by coating the surface with a material that incorporates such texture, or by conducting several roughening methods. Since galvanized steel is already a coated material, the incorporation of a second coating may be undesired. On the other hand, the methods that are recurrently used to incorporate the surface texture leading to superhydrophobicity in metals are aggressive and may damage their surface. In this work, we used a novel strategy which goal is to produce superhydrophobic galvanized steel by a two-step non-aggressive process. The first process is aimed to create a hierarchical structure by incorporating zinc nanoparticles sintered on the surface at a temperature slightly lower than the zinc's melting point. The second one is a hydrophobization by a thick fluoropolymer layer deposition. The wettability of the samples is characterized in terms of tilting plate and bouncing drop experiments, while the roughness is analyzed by confocal microscopy. The durability of the produced surfaces was also explored.

Keywords : galvanaized steel, superhydrophobic surfaces, sintering nanoparticles, zinc nanopowder
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