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Bioinspired superhydrophobic steel surfaces

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Superhydrophobic surfaces on alloyed steels were fabricated with a non-conventional method of plasma etching and subsequent water immersion procedure. High aspect ratio nanopatterns of nano-flake or nano-needle were created on the steels with various Cr content in its composition. With CF4 plasma treatment in radio-frequence chemical vapor deposition (r.-f. CVD) method, steel surfaces were etched and fluorinated by CF4 plasma, which induced the nanopattern evolution through the water immersion process. It was found that fluorine ion played a role as a catalyst to form nano-patterns in water elucidated with XPS and TEM analysis. The hierarchical patterns in micro- and nano scale leads to superhydrophobic properties on the surfaces by deposition of a hydrophobic coating with a-C:H:Si:O film deposited with a gas precursor of hexamethlydisiloxane (HMDSO) with its lower surface energy of 24.2 mN/m, similar to that of curticular wax covering lotus surfaces.

Since this method is based on plasma dry etching & coating, precise patterning of surface texturing would be potential on steel or metal surfaces. Patterned hydrophobic steel surfaces were demonstrated by mimicking the Robinia pseudoacacia or acacia leaf, on which water was collected from the humid air using a patterned hydrophobicity on the steels. It is expected that this facile, non-toxic and fast technique would accelerate the large-scale production of superhydrophobic engineering materials with industrial applications.

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