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Superhyrophobic Surface, Theory, Applications and Technological Importance

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Abstract- Superhydrophobic surfaces and materials received great attention of scientists and engineers due to their unwetting, self cleaning and antimicrobial properties. Hydrophobic surfaces are defined as having sessile water drop contact angle greater than 90°, while surfaces with contact angles larger than 150 ◦ are rendered as superhydrophobic. Superhydrophobic surfaces, originally inspired by nature, have attracted an increasing scientific and technological interest in the past few decades. In nature superhydrophobic character is common to many plants, such as lotus leaves.

The hydrophobicity can have its source chemically and/or topographically. While the former is explained on the basis of Young's theory, the latter is modeled by Wenzel and Cassie-Baxter models. The Young's model states that a smooth solid surface with a lower free energy has a higher sessile liquid drop contact angle since any isolated system changes to achieve a minimum free energy. Whether a smooth surface is hydrophilic or hydrophobic depends on the solid-liquid and solid-air interfacial energies. Wenzel model states that the contact between a rough solid surface and a liquid is uninterrupted, and the increased surface area of the solid due to roughness causes a chemically hydrophilic surface to have a further decreased contact angle, while on a chemically hydrophobic surface the contact angle rises above that of the smooth surface. However, Cassie-Baxter model assumes air pockets to be trapped between the rough solid surface and the liquid and a chemically hydrophilic surface may become hydrophobic and vice versa depending on the solid-air, liquid-air interfacial energies. The superhydrophobicity is a required property especially for keeping the surfaces free of wetting, and thus avoiding contamination by water based slurries, suspensions, and solutions. These types of surfaces are also classified as self-cleaning due to the difference in advancing and receding contact angles

Superhydrophobicity has stimulated much scientific and industrial interest because of the applications such as stain resistant, self-cleaning, low friction, antifouling, anticorrosion surfaces. Many hydrophobic surface structures have been developed in many fields, such as aeronautics industries, wind turbines, electric power lines, photovoltaic cells, heat exchangers, ice slurry generators are to name just a few. In this study the scientific and technological studies research and development of superhydrophobic surfaces and surface coatings and their theoretical background have been reviewed.

Keywords- superhydrophobicity, surface chemistry, roughness, hysterisis, contact angle