University of Crete
Department of Physics

Physics Colloquium

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Development of Functional Surfaces

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ABSTRACT

The design of functional surfaces based on biomimetic structures has gained the interest of the scientific community. Such biomimetic structures can be achieved either by using suitable coatings onto appropriately micro/nano-structured substrates or by using nanostructured hybrid coatings onto surfaces. Hierarchically roughened surfaces can be prepared by irradiating a metallic or semiconductor surface using ultrafast (femtosecond) laser or by utilizing polymer nanocomposite coatings when a soft substrate surface is to be modified; suitable chemistry of the coatings provides the desired functionality. We will demonstrate different cases. The utilization of end-anchored polymer chains onto hierarchical Si surfaces results in surfaces that exhibit reversible and controllable wettability to temperature and/or pH from the "parahydrophobic" behavior of natural plant leaves all the way to superhydrophilic properties in response to external stimuli. When a metallic surface is irradiated by femtosecond laser pulses, a hierarchical surface of high energy is produced. When such a surface remains under low temperature heating or under moderate vacuum, superhydrophobic metallic surfaces can be developed with controllable water adhesion. When a polymeric film needs to be modified, polymer nanocomposite coatings can be utilized onto the soft substrate; the polymer matrix of the coating provides the proper functionality whereas the inorganic (nano)particulate additives create the appropriate roughness. This results in superhydrophobic and water-repellent surfaces with self-cleaning ability and, at the same time, (super)oleophobic ones. A similar methodology can also be used to modify hard or soft surfaces utilizing waterborne functional coatings, which can be applied by dipping or spraying, with anti-fouling and anti-bacterial properties. Acknowledgements: This research has been co-financed by EU and Greek national funds (Horizon Europe project STOP, Grant Agreement 101057961; Horizon 2020 project FEMTOSURF, Grant Agreement 825512; Action RESEARCH – CREATE - INNOVATE, project INGRECO, MIS: 5030174).

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