REVERSIBLY UV-LIGHT-INDUCED HYDROPHOBIC/OLEOFILIC TO AMPHIPHILIC SURFACE TRANSITION IN THIN FILMS OF ORGANIC-CAPPED TiO₂ NANORODS

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Nanocrystalline TiO₂ is among the most studied semiconductor oxides, owing to its low-cost widespread applications in light-assisted environmental clean-up, in solar energy conversion, in sensing, and in the photodynamic deactivation of micro-organisms and of malignant cells. More recently, it has been discovered that UV-irradiation of TiO₂ surfaces rapidly converts them from an initially hydrophobic state to a highly amphiphilic one, followed by a slow back-recovery of the starting properties under ambient conditions. 1-4 These findings have stimulated the fabrication and the study of inorganic coatings which exhibit simultaneous self-cleaning and antifogging behaviour. 5, 6 However, the understanding the mechanism leading to light-induced wettability modification on TiO₂ surfaces remains elusive yet and the ability to control them has to be developed further.

In this contribution we will present a novel approach to engineer TiO₂ surfaces with UV-switchable wettability, which relies on the use of organic-capped TiO₂ nanorods (NRs) 7 for the fabrication of thin films made of close-packed laterally aligned arrays of TiO₂ crystalline domains exposing well-defined light-active crystal facets. As opposed to conventional polycrystalline or single-crystal TiO₂ surfaces, such NR-based films exhibit a reversible surface transition from a highly hydrophobic/oleofilic state (water and octadecene contact angles of 110° and 8°, respectively) to a highly amphiphilic state (water and octadecene contact angles of 20° and 3°, respectively) under remarkably milder UV-irradiation conditions (energy density as low as 1-2 mJ/cm²). By using a combination of techniques (XRD, HRTEM, SEM, UV-vis, FTIR and Raman spectroscopy, and contact angle measurements), we will demonstrate that the observed light-driven wettability changes are accomplished by progressive hydroxylation of the TiO₂ surface irrespective of the presence of the native shell of surfactant molecules, which simultaneously undergo conformational changes without suffering for significant photocatalytic degradation.

References

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