Hydrophobicity of Nanostructured Films Characterized by a Quartz Crystal Microbalance

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Two types of nanostructured polymer films were fabricated and measured with a novel quartz crystal microbalance (QCM) technique to investigate their static and dynamic hydrophobic properties. The nanofibrous films of polymethyl methacrylate (PMMA), PMMA/Polydimethylsiloxane (PDMS) and Polyacrylonitril (PAN) were prepared with an electrospinning process and a PMMA nano-roughened surface was fabricated using nanoimprint lithography (NIL), and both films were coated on QCM surfaces. Different static and dynamic hydrophobicity (wettability) were obtained and characterized by evaluating the mechanical impedance of QCM with DI water and air on these films. It was found that QCM is able to quantitatively characterize the hydrophobicity of these nanostructured polymer surfaces. For nanofibrous films, the double layers - a viscoelastic nanofiber film and a liquid layer result in a nonlinear combination of mechanical impedances. To simplify the analysis, an apparent viscosity was introduced in the analysis to account for interaction between liquid and polymer surfaces. For NIL films, the hydrophobicity was altered by coating nano-roughened surface with a Teflon layer. The reduction in mechanical impedance of QCM clearly demonstrates the effect of enhanced hydrophobicity. The experimental results showed that the hydrophobic surface resulted in smaller mechanical impedance loading, while the hydrophilic surface exerted much large mechanical impedance.

Keywords: Hydrophobicity, Quartz Crystal Microbalance, Nanostructure.

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