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High-wavelength, low-energy photochemical surface engineering

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Abstract

Surfactants can be used to curtail the issue of particle agglomeration for nanoparticles in liquid suspensions, though this quick fix is not applicable to every situation. In fact, many surfactants tend to desorb from the surface at temperatures as low as 70°C. Given that many applications involve exposure to higher temperatures either during the course of their useful life (i.e. nanofluids) or during their synthesis (i.e. nanocomposites), this limitation must be addressed. Functionalization, a process by which a strong covalent bond is used to attach the functional group to the surface, is a viable alternative to surfactant use to alter surface properties. Our research group focuses on gas-phase functionalization technique called photo-initiated chemical vapor deposition (PICVD), an approach that shows significant potential for both surface and particle functionalization on a large scale by using UV light to initiate gas phase radical polymerization. The advantages of this technique are potentially tremendous: lower energy consumption, operation under normal conditions and usage of common material and reactants. It is also simpler and more versatile than the ubiquitous solvent-based methods currently favored. The feasibility of using PICVD for the functionalization of surfaces has been investigated using a syngas-based precursor. The results suggest that the surface properties can be finely tailored by controlling the kinetics involved in the PICVD reactor. Indeed, surfaces with wettability ranging from superhydrophilic to hydrophobic have been prepared and characterized via water contact angle measurements. FTIR measurements of the coating show that the polymeric film is composed of a highly cross-linked, functional resin.

Biography

Prof. Jason R. Tavares earned his Ph.D. in Chemical Engineering at McGill University in 2010 and spent some time as a product development scientist in a local environmental engineering firm. He joined Polytechnique Montreal in 2011 as an Assistant Professor, where he is head of the PhotoSEL (Photochemical Surface Engineering Laboratory). His research team includes Mr. Christoper-A. Dorval-Dion, a master's student and Chemical Engineering graduate focusing on the development of the novel, high-wavelength photo-initiated CVD method.