Journal of Research and Reports on Metals

Opinion

A SCITECHNOL JOURNAL

Determination of the monolayer coverage of silica particles

Angelo La Rosa

London South Bank University, United Kingdom

Abstract:

Extreme weather conditions present significant challenges in several industrial sectors, such as automotive, wind energy, industrial cryogenics and aerospace. Passive solutions are important for achieving long term-functional performance. However, an effective, durable passive anti-icing or deicing surface has been yet to be demonstrated, indicating significant necessity for developments. Introducing enhanced chemical repellency and structured roughnesses into surfaces are two of the best candidates to achieve this main goal. Realizing these characteristics via the introduction of suitably functionalized silica nanoparticles represents an emerging approach that allows the modification of existing coatings and composite materials. Selective and specific functionalization of these silica particles is crucial in order to achieve a monolayer coverage avoiding partially covered particles or a surfeit of unreacted silane which may have undesirable impacts on the materials processing or ultimate properties. The primary aim of this study was to establish methods to determine the degree of functionalization and to identify the monolayer coverage of tailored silica particles. A model family of silica particles with diameter of approximately 35 nm was produced using a refined stober method. These silica particles were functionalized using hexamethyldisilazane (HMDS). Particle size analysis using dynamic light scattering methods was undertaken to determine the impact of functionalization on the average diameter and size distribution within the suspension. Drop Shape Analysis (DSA) was used to evaluate the repellency of a dried film of the functionalized silica particles deposited onto a glass slide. As the degree of functionalization increases, the repellency of the film also increases to a maximum value followed by a plateau where increasing silane has little impact on the repellence. Thermogravimetric analysis was also used to assess the weight loss versus the grafted silane onto the surface of the silica particles. This info provided an indication at which point the monolayer coverage of the TWI silica nanoparticles grafted with HMDS can be inferred. This study provides the underpinning approach that allows the establishment of monolayer coverage and optimization of the coacervation of silica particles.

Biography:

Angelo La Rosa is pursuing his PhD in the School of Engineering at London South Bank University. Currently his research studies include in-depth comprehension of the mechanisms involved to graft the surface of the silica particles with tailored silanes. His PhD work is involved in Work Package 2 (WP2) of the EIROS European project which aims to fabricate advanced materials having anti-erosion and anti-icing properties through the incorporation of super hydrophobic silica particles as additive material into available-in-the-market-materials (epoxy resins or paints). The work is carried out into the National Structural Integrity Research Centre, a state-of-the-art postgraduate engineering facility established and managed by structural integrity specialist TWI.