Constantinos Mina

Polydimethylsiloxane (PDMS) Nanocomposites for Energy and Environmental Applications

During the last two decades polymer nanocomposites have attracted the attention of research and technological community due to the significant improvements that the nanoscale reinforcements can entail. In conjunction with the rapid advancement of manufacturing tools it is nowadays possible to control matter in nanometric dimensions with an unprecedented opportunity for material property control, tailored for specific applications.

This thesis studies the use of Polydimethylsiloxane (PDMS) for the synthesis of polymer nanocomposites for two specific applications: (a) nanocomposite coatings for improved solar harvesting abilities and (b) foams for selective absorption of fluids. PDMS, which is commercially available, is characterized by many interesting properties. It is optically transparent, thermally stable, hydrophobic, nontoxic and nonflammable. Its ease of manipulation probably constitutes its' most important trait, as the combination of desirable characteristics for specific applications is now possible.

In the first part of this thesis we studied the creation of PDMS-silver multilayer systems for improved solar absorbance. Silver has been deposited using a sputter coater whereas the PDMS layers have been spin coated. The material systems have been microstructurally characterized using Scan Electron Microscopy (SEM) and Atomic Force Microscopy (AMF) and optically characterized using uv/vis Optical Spectroscopy. Multilayer systems with enhanced solar absorption characteristics are presented in the thesis.

The second part of this thesis deals with the synthesis of hydrophobic porous PDMS with selective absorbance of oil capabilities. Synthetic and biological sponges are investigates in this study. The synthesized specimens have been characterized in terms of their microstructure (AFM and SEM), their hydrophobicity (wetting angle) and in terms of their ability to selectively absorb oil in water. Specimens with such capabilities are delivered.