Proceedings of the World Congress on New Technologies (NewTech 2015)
Barcelona, Spain – July 15 - 17, 2015
Paper No. 370

Microencapsulation of Three Component Core System by In-situ Polymerization Process

Sourav Sarkar, Byungki Kim
School of Mechatronics Engineering, Korea University of Technology and Education,
1600 Chungjeol-ro, Byeongcheon-myeon, Dongnam-gu, Cheonan, Chungnam, 330-708
Republic of Korea
sourav@koreatech.ac.kr; byungki.kim@koreatech.ac.kr

Extended Abstract

The present work is about microcapsules and the microencapsulation process. The central idea of using the microcapsules as a self healing agents has been to mix them into the composite polymer matrix (the structural polymer) so that when the crack generated by outside influences propagates, the microcapsules will get ruptured at the tip of the crack releasing the core material which will polymerize to stop the crack propagation and thereby will stop the eventual collapse of the material. The goal was to make a certain type of microcapsule which after getting ruptured during crack propagation won't need any expensive catalyst to initiate the polymerization process and can readily be embedded in the matrix of graphene based composite materials. The core material was chosen to be the complex of graphene oxide (GO) and epoxy resin (EPON 828) with acetone playing the role of solvent. GO was dispersed in acetone through ultra-sonication followed by treatment with epoxy in a shear mixer. 2.5 wt% ethylene maleic anhydride surfactant solution was added to 200ml water followed by specific amount of urea, resorcinol and ammonium chloride (NH_4Cl). pH was maintained at 3.5. The core material with solvent was added after 10 minutes. After a short while formaldehyde (HCHO) was added which along with urea was the main component of the shell material of the microcapsule. Resorcinol acts as cross linking agent and NH_4Cl reacts with HCHO to generate surface active substances which drives the formed microcapsules to enrich the surface of the dispersed phase. The formed microcapsules was analysed through scanning electron microscopy (SEM) and the core materials were tested using the Thermogravimetric Analysis (TGA) and Differential Scanning Calorimetry (DSC) analysis. The diameter of the microcapsules depended very closely with the stirring rate of the mechanical stirrer. Generally high stirring rate tends to make the diameter of the microcapsules smaller in size. The mean diameter of the microcapsules were in the range of 5-120μm but in case of the GO-epoxy-solvent core the smaller microcapsules were found to be more stable. The thermal stabilities of the microcapsules were compared with other microcapsules with only epoxy-solvent core prepared through same procedure. TGA studies of the core revealed greater thermal stabilities for graphene-epoxy core. Urea-formaldehyde shell of the microcapsules with GO-epoxy-solvent was also thermally more stable as the shell remained largely intact till 210ºC whereas microcapsules with only epoxy core started decomposing from 130ºC implying that GO has played an important part in the thermal stabilisation of the shell due to its attachment with the urea-formaldehyde shell material. It was found that increasing weight percentage of GO in the preparation procedure tends to provide more overall thermal stability of the microcapsules. The novelty lies in successfully encapsulating the GO-epoxy-solvent in the microcapsules which can be used to provide self healing character in graphene based structural composite materials.