

Structural and thermal characterizations of silica nanoparticles grafted with pendant maleimide and epoxide groups

Abstract

Grafting of free maleimide and epoxide pendant groups onto the surface of approximately 7-nm silica nanoparticles was investigated. Glycidyloxypropyl groups (3-glycidyloxypropyltrimethoxysilane and 3-aminopropyltrimethoxysilane) that carried epoxide groups and aminopropyl groups were grafted to the silica surface with the help of condensation reactions. Maleimide groups [1,1'-(methylenedi-4,1-phenylene) bismaleimide] were introduced to the silica surface via nucleophilic addition reaction with the aminopropyl groups pre-grafted onto the surface. The grafted silica samples were characterized using CHN, FTIR, DSC, TGA-FTIR, and ^{13}C and ^{29}Si CP/MAS NMR spectroscopy. NMR analyses revealed that all the functional groups were covalently bonded to the silica surface and most of the maleimide and epoxide rings remained intact on surface. DSC analysis showed that the epoxide groups were more reactive than the maleimide groups.