

# **EFFECT OF CHANGING SILICA SURFACE ENERGY ON MELT RHEOLOGY AND STRUCTURE OF PS/SILICA NANOCOMPOSITES**

**M.A. Sanjari Shahrezaee, F. Goharpey, R. Foudazi**

Department of Polymer Engineering, Amirkabir University of Technology, Tehran, Iran

goharpey@aut.ac.ir

Attempts were made to investigate the effect of silica surface energy on the rheology and aggregation of polystyrene (PS) filled nanocomposites. The dispersion state of different silica nanoparticles in PS matrix was characterized by scanning electron microscopy (SEM). Rheometric mechanical spectrometry (RMS) was employed to study the linear and non-linear melt viscoelastic properties of prepared nanocomposites. The results showed that the lower the particle surface energy, the higher dispersion can be achieved due to the decrease in particle-particle interactions and reduction of work of adhesion between polymer matrix and particles. The results showed that when the surface energy difference between nano-silica and polymer matrix is high, there is a strong tendency for silica nanoparticles to aggregate. A solid like behavior which was observed at low frequencies, was decreased by reduction of particle surface energy due to lower particle-particle interactions. Lower overshoot in start-up experiment and quicker stress relaxation indicates the lower extent of aggregation and higher dispersion of nanoparticles with higher hydrophobicity. Enhancement of glass transition temperature and relaxation time of nanocomposite with increasing particle surface energy indicated the confinement of polymer chains in particle's aggregate. Also the effect of changing surface energy on the content of adsorbed polymer chains on silica particles has been investigated by using thermogravimetric analysis (TGA) method. Moreover, the structure of the filler network was studied using both the percolation and fractal approaches. Results showed that particles with higher hydrophobicity form aggregates with lower fractal dimension and percolation threshold. Since in this system the particle-particle interactions mechanism is dominant, we utilized Yziquel and coworkers' model to predict the stress-growth behavior of PS nanocomposites upon start-up of shear flow.