TiO_2 Polymer Nanocomposites

In conjunction with Dr. Ashok Kumar in the Mechanical Engineering Department at USF, we conducted *in-situ* free radical syntheses and characterization of titanium oxide/PMMA nanocomposites (0.005-5 vol % nanofiller) (15). TiO_2 nanocomposites are of interest for high strength to weight applications, as well as for use in UV filters (16-18). In addition, if the filler particle size is less than that of the light transmitted through it, the particles do not scatter light and yield transparent composites in transparent polymer matrices. The refractive index of rutile TiO_2 is 2.6 to 2.9 depending on the wavelength used for the measurement (19). This allows one to design transparent composites with tunable refractive indexes. Disks of 1.2 mm thicknesses effectively screened UV light without significantly reducing transparency at concentrations up 0.1 vol %. While the filler did not influence microhardness numbers, the nanoparticles significantly influenced fracture toughness. Loadings of 0.5, 1.0 and 3 vol. % increased toughness by 11%, 100% and 77% respectively as compared to neat PMMA. A 5 vol. % sample had the lowest fracture toughness, a decrease of 22 % as compared to the neat sample. The initial increase in fracture toughness followed by the decrease is related to the extent of agglomeration. The higher filler loadings exhibit extensive scattering in the visible regions of the electromagnetic spectrum. In addition, powder X-ray diffraction studies indicated that the 3 and 5% samples exhibited the largest crystallite size. This indicates the formation of agglomerates with a preferred orientation.

References

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