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Thermoplastic Nanocomposites and Nanofoams via Sol/Gel-Reactions in Polyamide Melts

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Melt processing of thermoplastic nanocomposites requires formation and dispersion of nanometer scaled inorganic particles, which adhere to the polymer matrix and do not form large clusters. Most conversant melt processable nanocomposite require multi-step nanofiller preparation in conjunction with the use of tailor made compatibilzers. These separate filler preparation steps can be omitted when inorganic sols are fed into polymer melts. Various aqueous sols and organosols, including silica and alumina dispersions, were evaluated. Monodisperse silica nanoparticle, obtained via the Stoeber process, gave dispersions of nanosilica ranging from 45 to 75 nm. Mechanical properties of the in-situ polyamide nanocomposites were compared with those of conventional organoclay nanocomposites. Semi-fluorinated silanes afford polyamide nanocompounds exhibiting contact angle of 77°. Thermal decomposition of the semi-fluorinated nanosilicates accounted for the formation of silicate reinforced nanopores. The silica reinforcement prevented collapse of the nanopores. Polyamide 6 contained individual silicate reinforced nanopores exhibited larger elongation of break of around 140 % at 4.5 wt.-% silica content. Basic structure/property correlations and the role of processing conditions will be discussed.