

Nanoscale Polymer Processing

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Polymeric materials have tremendous potential for nano and micro-structured products because of their fabrication ease and wide property range. They are biocompatible, biodegradable, and flexible (low modulus). In contrast to other manufacturing, the fabrication processes for polymers are cost-effective and rapid. We have developed novel manufacturing approaches for the incorporation of nano/microscale functionality that are environmentally friendly (melt-based) and industrially relevant. The fabrication of nanocomposites (thermoplastic polymers with nanoclays, CNTs, silver nanoparticles, etc.), in a continuous, melt process (twin-screw extrusion) can yield excellent dispersion. Three dimensional micro/nanostructures have been fabricated in the surface of a part using injection molding; producing parts in under 30 seconds. Applications include microfluidic chips and hydrophobic and ice phobic surfaces. Multilayer films, with micro or nanolayers, using different polymers and nanoparticles can be fabricated using a modified extrusion process for applications in optical films and barrier packaging. Nano or micro-structured surfaces with patterns of different polymers or nanoparticles (conducting/nonconducting) can be made with directed assembly and transfer to a polymer substrate. These unique structures could be used for flexible electronic devices, metamaterials, structural nanocomposites or biocompatible material applications. Continuous roll to roll processes provide economic fabrication.