

Materials Day 2007: Sticking and Sliding, Wearing and Tearing

Tribology and Adhesion Issues in Materials Science

«Wearing and Tearing of Designer Polyethylenes»

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Abrasive wear is a complex phenomenon, generally thought to be dependent on numerous factors that include the physicochemical nature of the various materials, surfaces and interfaces involved, and the presence or absence of lubricating agents or other foreign matter. In many applications where resistance to wear is demanded, the material of choice is ultra-high molecular weight polyethylene (UHMWPE). Unfortunately, UHMWPE has one major drawback: due to its high melt viscosity (zero-shear viscosity in excess of 10^8 Pa.s), common polymer processing techniques, i.e. extrusion, injection molding or blow molding, are not practicable. Instead, typically, cumbersome and uneconomical slow processes such as compression molding or ram extrusion are used to sinter UHMWPE powder into semi-finished sheets or rods, which are, subsequently, machined into the desired shape. This study addresses the molecular and morphological parameters that govern the abrasive wear of polyethylenes. It will be shown that careful tuning of molecular weight, molecular weight distribution and comonomer content opens the route to new melt-processable polyethylene grades with ultra-high resistance against abrasive wear that equals or surpasses that of UHMWPE, but unlike the latter material, can be shaped into useful objects with common, efficient melt-processing techniques.