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Surface Mechanical Characterization of Semicrystalline Polymers

Effective selection and design improvements of materials in surface engineering and tribological applications require knowledge of their near-to-surface mechanical properties. A better understanding and control of the surface mechanical properties of polymers is required for their optimal use as engineering materials. This is particularly important when these materials are used to improve the contact mechanical properties, where polymers are adopted in optical, coatings and plastic engineering applications for consumer products, or tribological performance of bearings. Therefore, this experimental study seeks to elucidate an understanding of the response of semicrystalline polymers in single point contacts. The experimental study is based upon the indentation and scratching techniques for surface mechanical property characterization. Indentation is a relatively simple and virtually non-destructive means of assessing mechanical properties of materials by an indenter, inducing a localized deformation into a solid surface. The load-displacement curves, the hardness, the elastic modulus, the plasticity index and the creep response data and associated analysis for polymeric surfaces are presented as a function of the contact displacement. Scratching of an asperity contact on the material surface is one of the most significant stresses from the widest range of chemical and mechanical stresses that a solid polymeric product might experience in its life. The scratching process is a well known concept and is generally defined as a kind of surface abrasion, provoked by the relative friction of two material objects where one is significantly sharper and harder than the other. Perceiving, or assessment, of a scratch is usually correlated to the visual detection by the observer as these may be of any size and length. Scratches were produced on polymeric surfaces using rigid cones of different cone included angles and under different normal loads. The prevailing deformation mechanism and geometry of damage on the scratched polymeric surfaces were assessed using scanning electron microscope (SEM) and an optical profilometer. Deformation maps of the polymeric surfaces have been constructed under various contact conditions using the scratching technique. These maps provide a convenient means to report the deformation behaviour of the polymeric surfaces when the imposed scratch conditions are changed. The penetration depth of the imposed scratch in the material has a significant bearing on the resultant deformation, in addition to the previously reported effects of the indenter velocity, normal loads and attack angle.

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