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A phenomenological elevated temperature friction model for viscoelastic polymer coatings based on nanoindentation

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Abstract

We propose a phenomenological elevated temperature (260 °C) friction model for viscoelastic polymer coatings based on high temperature nanoindentation. Two advanced polymeric coatings were selected for this study, namely Aromatic Thermosetting Polyester (ATSP) and Polyetheretherketone (PEEK). High temperature up to 260°C nanoindentation experiments were conducted at the same temperatures as macro-scale ball-on-disk tribological experiments at different temperatures. Hardness was directly measured from the indentation experiments and viscosity/relaxation and elastic modulus were obtained by curve fitting of the nanoindentation's unloading curve using a quadratic Maxwell model. The two coatings showed decreasing hardness, elastic modulus and viscosity/relaxation trends, with increasing temperature. The ATSP coating exhibited higher indentation recovery rate and higher hardness, and thus better wear.

Keywords: Friction model; viscoelastic; elevated temperature nanoindentation; polymer coating

List of Symbols

A_1	Nominal area of contact
A_r	Real contact area between the pin and disk
d	Width of the square pin
d'	The polymer's overall deformation
E	Elastic modulus of viscoelastic material