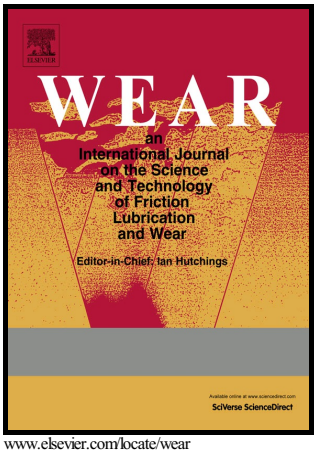

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PII: S0043-1648(17)30342-3
DOI: http://dx.doi.org/10.1016/j.wear.2017.02.033
Reference: WEA102087

To appear in: *Wear*

Received date: 16 June 2016
Revised date: 13 January 2017
Accepted date: 10 February 2017

Cite this article as: C.H. Sacré, F. Lani, Ph. Guaino, L. Libralesso, A. Favache and T. Pardoen, Effect of polymer interlayer on scratch resistance of hard film experiments and finite element modeling, *Wear* http://dx.doi.org/10.1016/j.wear.2017.02.033

Effect of polymer interlayer on scratch resistance of hard film: experiments and finite element modeling

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Abstract

The scratch resistance of thin ZnO films deposited on a polyimide interlayer is characterized experimentally and simulated using a 3D finite element model. Nanoscratch tests combined with scanning electron microscopy observation to analyze the failure mechanisms in the brittle hard films are performed. The thickness of the polymer interlayer is shown to play a major role in controlling the scratch depth and the initiation of the cracks in the top hard coating. The main feature dictating the scratch resistance is related to the development of the pile-up in front of the indentation tip. The amplitude and morphology of the pile-up is affected by the polymer constitutive behaviour and by the constraint induced by the limited thickness. The finite element simulations accurately capture the changes in pile-up development with different soft interlayer thicknesses as well as, based on a simple maximum principal stress criterion, the onset of the cracking process.

Keywords: nanoscratch, thin films, oxide, fracture, polymer, FEM