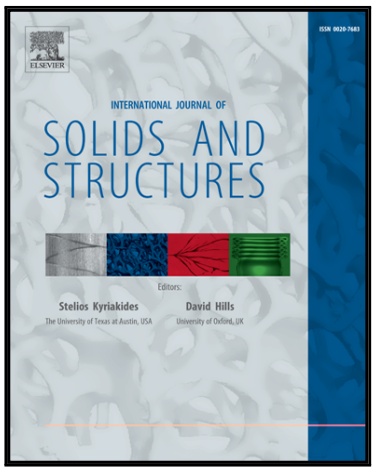

Rough contact mechanics for viscoelastic graded materials: The role of small-scale wavelengths on rubber friction

Michele Scaraggi, Davide Comingio

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Rough contact mechanics for viscoelastic graded materials: The role of small-scale wavelengths on rubber friction

Michele Scaraggi[1,2,*],Davide Comingio[1]

[1] *DII, Universitá del Salento, 73100 Monteroni-Lecce, Italy*

[2] *Department of Mechanical Engineering, Imperial College London, South Kensington Campus, Exhibition Road, London SW7 2AZ, UK*

Abstract

We discuss on the rough contact mechanics in presence of a graded viscoelastic solid. In particular, we derive the effective surface admittance of a stepwise or continuously-graded half-space, which is then embedded in a Fourier-based residuals molecular dynamics formulation of the contact mechanics. The viscoelastic multilayer theory, which is of general applicability, is then applied to discuss on the role of small-scale wavelengths on polymer friction and contact area. We demonstrate that the rough contact mechanics exhibits effective interface properties which converge to asymptotes upon increase of the small-scale roughness content, when a more realistic rheology of the confinement is taken into account.

Keywords: Bufler's approach, coating, FGM, graded viscoelasticity, multilayered, rough contact mechanics, roughness, rubber friction, sliding friction, wear modified surface layer.

1. Introduction

The rough contact mechanics of solids exhibiting graded rheology (also named functionally graded materials, FGM) is of major interest for both technological [1] (e.g. seals, rubber friction, tribology of protective coatings) and biological (tissue engineering, bio-lubrication in the-bone cartilage contact) applications, to cite few. As an example, the nanometer- to micrometer-scale control of the chemo-mechanical properties of surfaces, leading to advanced functional materials with nominally unlimited range of application, is attracting an increasing interest in the fields of biomedical materials and regenerative medicine[2]. Thus, among the many potential applications, polymeric coatings (e.g. produced though the layer-by-layer deposition process, or by hybrid pulsed laser deposition, to cite few) are nowadays adopted to functionalize surfaces in order to regulate the cell adhesion process[3], which is well known to be affected by the surface physicochemical properties (such as interface stiffness[4]). Moreover, in poly-

* Corresponding author

michele.scaraggi@unisalento.it