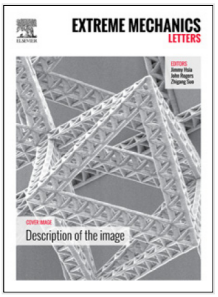
Accepted Manuscript



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PII: S2352-4316(15)30065-1
DOI: http://dx.doi.org/10.1016/j.eml.2016.04.005
Reference: EML 160

To appear in: *Extreme Mechanics Letters*

Received date: 29 December 2015
Revised date: 1 April 2016
Accepted date: 18 April 2016

Please cite this article as: H. Hu, C. Huang, X.H. Liu, K.J. Hsia, Thin film wrinkling by strain mismatch on 3D surfaces, *Extreme Mechanics Letters* (2016), http://dx.doi.org/10.1016/j.eml.2016.04.005

Thin Film Wrinkling by Strain Mismatch on 3D Surfaces

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Abstract

Wrinkling of thin films in micro- and nanoscale has found wide applications in stretchable electronics, optical gratings, material characterization, and biology. However, most wrinkling work is in planar fashion and only limited work on 3D wrinkling has been reported. In this paper, we present experimental demonstration of 3D Cr film wrinkling on PDMS micro-ridges induced by strain mismatch. We first fabricated PDMS micro-ridges using replication from a silicon mold, prepared by conventional microfabrication processes. While pre-stretching the PDMS specimen along the ridge direction, thin Cr film was deposited through physical sputtering. After releasing the prestrain, two wrinkling waves formed on the two inclined surfaces of the PDMS ridges with the same wavelength but opposite phases. These two wrinkling waves twist the top of the ridge into a wavy shape, forming wrinkling waves oscillating in the direction parallel to the substrate plane. In contrast, 2D wrinkling waves oscillate in the direction perpendicular to the substrate plane. Using finite element simulations, we demonstrate that the 180^o phase shift between the two

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