Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Instability of Viscoelastic Thin Films, and Applications SCOTT NORRIS, MICHAEL AZIZ, MICHAEL BRENNER, School of Engineering and Applied Sciences, Harvard University — An ion beam bombarding a solid surface has been long been known to produce an instability leading to a modulated surface (with ripples or dots); though the basic mechanisms for this instability remain under considerable debate. During our investigation of this problem, we have been led to a basic problem in thin film fluid mechanics: the instability of a viscoelastic thin film that is under compressive stress. This applies to the ion bombarded problem because there is evidence that the ion beam fluidizes a thin viscoelastic layer, and that this layer is then stressed by the ion beam. By varying the ratio of the shear modulus to the viscosity, we analyze this problem and connect the known limits of a stressed elastic solid film or a surface-tension driven lubrication flow. In particular, we identify the presence or absence of a surface instability as a function of these two parameters. We discuss the application of this model to the surface layer of an ion-sputtered target; and also discuss its potential application to the wrinkling instability of a growing biofilm attached to a substrate.

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Date submitted: 11 Aug 2009 Electronic form version 1.4