
Wrinkling patterns of stiff shallow film mounted on curved substrate under biaxial strain

Alexis Kordolemis*¹ and Antonios Giannakopoulos²

¹University of Greenwich – United Kingdom

²National Technical University of Athens [Athens] – Greece

Abstract

A thin film mounted on a compliant substrate under biaxial compressive strains wrinkles in different patterns such as cylindrical, checkerboard, herringbone and hexagonal. In this study, we provide a thorough analysis of the above wrinkling modes which have been well documented experimentally and numerically. Particular attention is paid to the role of the curvature-induced anisotropy in the geometrical characteristic of these particular surface wrinkling modes, i.e. the wavelengths in the two principal directions as well as the corresponding amplitudes.

The film is assumed to be much stiffer than the substrate and the bilayer system is cylindrically curved and is acted upon biaxial compressive strains. The film is modelled as a shallow shell with finite rotations while the substrate is assumed as a linear three-dimensional elastic solid. Utilising the minimization of the total energy of the system semi-analytical expressions for the critical values of the wavelengths and the corresponding amplitudes associated with the onset of the various wrinkling modes are provided.

The obtained results has been found to be in a very good agreement compared to experimental and numerical findings of other studies. It is shown that the presence of the initial curvature in the bilayer delays the critical strain and the wrinkling amplitudes significantly for all wrinkling modes, compare to the flat system, and moreover explains the inward buckling of the hexagonal mode which has been observed experimentally.

*Speaker