Numerical prediction of genesis and evolution of orographies in films wrinkling on 3D-shaped substrata

A. Cutolo[1], V. Pagliarulo[2], F. Merola[2], S. Coppola[2], P. Ferraro[2] and M. Fraldi[1]
[1]*Department of Structures for Engineering and Architecture, University of Napoli Federico II, Napoli - Italy*
E-mail: *arsenio.cutolo@unina.it, fraldi@unina.it*

[2] *Institute of Applied Sciences and Intelligent Systems (CNR-ISASI), National Research Council of Italy, Pozzuoli, Napoli - Italy*

E-mail: *v.pagliarulo@isasi.cnr.it, f.merola@isasi.cnr.it, s.coppola@isasi.cnr.it , p.ferraro@isasi.cnr.it*

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The proposed contribution is focused on wrinkles of thin metal films generated and driven by mechanical or thermal-induced stresses [1]. Wrinkles have recently found unforeseeable applications in surprising ways in many emerging fields since this process offers potential to generate planar and non-planar surfaces patterned in 1–100μm pitch range with height features at nanoscale over areas of square centimeters [2]. Thus, wrinkles formation could be formidable bottom-up process if the fabrication will become full a predictable and governable nano-micro-technology. However, full prediction is still a challenging ambition [3]. In fact, as a matter of fact, the intrinsic nonlinear nature of the mechanical response of these systems and the complex interaction occurring at the interface between thin layer and elastically inhomogeneous substrates require extremely expensive computational times and limit the use of closed-form solutions and thumb rules, especially if some symmetries and shape regularities of the overall constructs are lost [4]. To contribute to overcome these obstacles in modeling compliant film wrinkling in non trivial cases of interest, a new hybrid analytical-numerical (Finite Element-based) strategy is here proposed to drastically reduce the computational costs of in-silico simulations and to gain both qualitative and quantitative results for predicting wrinkle profiles, including onset and progressive evolution of wrinkling films nano-orographies.

References

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