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A bulge test based methodology for characterizing ultra-thin buckled membranes

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Abstract

Buckled membranes become ever more important with further miniaturization and development of ultra-thin film based systems. It is well established that the bulge test method, generally considered the gold standard for characterizing freestanding thin films, is unsuited to characterize buckled membranes, because of compressive residual stresses and a negligible out-of-plane bending stiffness. When pressurized, buckled membranes immediately start entering the ripple regime, but they typically plastically deform or fracture before reaching the cylindrical regime. In this paper the bulge test method is extended to enable characterization of buckled freestanding ultra-thin membranes in the ripple regime. In a combined experimental-numerical approach, the advanced technique of digital height correlation was first extended towards the