Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Wavefront Kinetics of Plamsa Oxidation of Polydimethylsiloxane: Implications for Micropatterning Size Limits by Wrinkling[1] ANGUS BAYLEY, JOAO CABRAL, JOANNE LINGLING LIAO, Imperial College London, ARNAUD CHICHE, DSM Material Science Centre, PAUL STAVRINOU, Imperial College London — We investigate spontaneous wrinkling of bilayers under compressive strain as a means of producing highly ordered micropatterns that span macroscopic areas. Our focus is a fast track wrinkling method, involving plasma oxidation of pre-stretched elastomeric polydimethylsiloxane (PDMS), which when subsequently relaxed forms one-dimensionally aligned sinusoidal surface undulations. For the first time, we evaluate this micropatterning method in terms of the range of geometries of 1D wrinkles it can produce. Our investigation reveals the presence of an apparent minimum wrinkling wavelength for a given value of prestrain (approximately 600nm for a prestrain of 10%), offering clues regarding the kinetics of glassy film formation on the surface of PDMS during plasma oxidation, which is subsequently investigated. X-ray reflectometry and analysis of wrinkling behavior for a selection of PDMS samples exposed to a range of plasma doses yields evidence that this transient film growth process is not dissimilar to the process of frontal photopolymerization. With the benefit of this finding, a route to further minimization of wrinkle periodicity - increasing processing pre-strain - is identified and subsequently implemented, allowing us to access periodicities as low as 140nm.

[1]We acknowledge the EPSRC for their funding of this work.

Angus Bayley
Imperial College London

Date submitted: 09 Nov 2012 Electronic form version 1.4