Abstract Submitted
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Dynamic measurement of the evolving mechanical properties of thin drying films via induced wrinkling[1] MANUELA NANIA, GIULIA FERRETTI, OMAR MATAR, JOAO CABRAL, Imperial College London — Surface patterning is important for controlled liquid spreading, adhesion and assembly of smart coatings. Patterns with feature sizes in the 100nm-100μm range can be achieved via wrinkling of bilayers, an inherently inexpensive, scalable and robust method. Conversely, measuring wrinkling of well-defined bilayers and multilayers represents a valuable way to measure mechanical properties of laminate thin films supported by well-defined substrates. We focus on the dynamic measurement of the elastic modulus of micrometer scale layers of ternary solutions during drying and film formation. Aqueous salt model solutions are cast on pre-stretched, oxidised polydimethylsiloxane, and allowed to dry under controlled environments, leading to thin film formation. Upon strain removal, different pattern morphologies are observed and mapped as a function of composition, drying time, temperature and relative humidity. Several classes of wrinkling behaviours are identified, from single frequency sinusoidal wrinkling to various complex modes involving stress localization and wrinkling cascades. Within sinusoidal wrinkling, we can infer dynamically the film elastic modulus evolution during drying from the pattern dimensions. The results are validated by AFM nanoindentation measurements.

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