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Cracking in thin films of colloidal particles on elastomeric substrates MICHAEL SMITH, JAMES SHARP, University of Nottingham — The drying of thin colloidal films of particles is a common industrial problem (e.g paint drying, ceramic coatings). An often undesirable side effect is the appearance of cracks. As the liquid in a suspension evaporates, particles are forced into contact both with each other and the substrate, forming a fully wetted film. Under carefully controlled conditions the observed cracks grow orthogonal to the drying front, spaced at regular intervals along it. In this work we investigated the role of the substrate in constraining the film. Atomic force microscopy, was used to image the particle arrangements on the top and bottom surfaces of films, dried on liquid and glass substrates. We present convincing evidence that the interface prevents particle rearrangements at the bottom of the film, leading to a mismatch strain between upper and lower surfaces of the film which appears to drive cracking. We show that when the modulus of the substrate becomes comparable to the stresses measured in the films, the crack spacing is significantly altered. We also show that cracks do not form on liquid substrates. These combined experiments highlight the importance of substrate constraint in the crack formation mechanism.

[1] M.I. Smith, J.S. Sharp, Langmuir 27, 8009 (2011)

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