

# Film Stress Detection via Beam Bending

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Latex film formation comprises of three stages; (I) evaporation, where water evaporates to bring latex particles into contact, (II) particle deformation, where further evaporation deforms the particles to eliminate voids and (III) polymer interdiffusion, where polymer moves across particle boundaries to give a continuous film with mechanical integrity. During film formation, the film experiences stresses that shape the final film morphology. The stress evolution is detectable using the beam bending technique.<sup>1</sup> A flexible substrate supports a latex film during drying. As the film forms, stresses generated are transferred onto the substrate, bending it. The substrate curvature change correlates to a film stress. For a soft latex ( $T_{\text{exp}} > \text{MFT}$ ), the stress builds up gradually before leveling off as a continuous film is formed. A hard latex ( $T_{\text{exp}} < \text{MFT}$ ), with its cracked film, produces a peak stress as the film approaches its final consolidation and then instantaneously relieves the stress as cracks develop. An intriguing aspect is the evidence of a dilational stress for a short period during film formation. This is speculated to be caused by particle transport to the edge of the film, giving rise to a network compression that then relaxes and causes film dilation.

## **Reference:**

[1] Petersen C, Heldmann C and Johannsmann D, Langmuir, 1999, 15, 7745.