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Fracture of brittle coatings on soft plastic substrates JOEL MARTHELOT, Massachusetts Institute of Technology, DAVY DALMAS, JEREMIE TEISSEIRE, SVI, CNRS, Saint-Gobain, JOSE BICO, BENOIT ROMAN, PMMH, ESPCI ParisTech — Mechanics of stiff and electrically conductive films deposited on soft plastic substrates have recently gain interest due to the development of stretchable electronics applications. When submitted to tensile stress, such films tend to fail with the apparition of arrays of parallel channel cracks transverse to the direction of deformation, with fatal consequenses for electrical conductivity. We study the propagation of such fractures in oxyde monolayers coated on a polymer substrate under uniaxial stretching. We show how the crack density undergoes a transition from a statistic failure distribution of brittle material to a deterministic failure set by the elastic mismatch between the film and the substrate. A two-dimensional model of a film bonded to an elastic substrate fails to describe the saturation observed at high strain. We present experimental evidences of the localization of strain in the substrate by in-situ AFM imaging of the fracture process. We propose an increment of the model to account for the plasticity of the substrate. This description allows to pass continuously from the elastic to the plastic regime and to predict the saturation of the fragmentation as observed experimentally at large deformation.

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