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**Low speed fracture instabilities in a brittle crystal** NOAM BERNSTEIN, JAMES R. KERMODE, TRISTAN ALBARET, DOV SHERMAN, PETER GUMBSCH, MICHAEL C. PAYNE, GÁBOR CSÁNYI, ALESSANDRO DE VITA — Brittle materials under mechanical load fail by nucleation and propagation of cracks, and these cracks show well known instabilities at high crack speeds. In this work we show that new instabilities caused by the atomic structure of the crack tip can occur at low crack speeds as well [1]. Using state of the art computer simulations, we find atomic rearrangements at a silicon crack tip on the (111) cleavage plane that occur preferentially on one side of the crack, but only at low crack speeds. Experiments using a novel technique for applying low tensile loads show that real silicon cracks form distinctive features on one side of the exposed crack surface. A mesoscopic model explains how the microscopic atomic rearrangements lead to the observed macroscopic features. We present extensive results on silicon and preliminary results on other brittle materials including sapphire, diamond, and silicon carbide. We conclude that even very brittle single-crystal materials can have a complex crack tip atomic structure, and that atomic scale rearrangements can lead to macropscopic changes in crack morphology. [1] J. R. Kermode *et al.*, Nature **455**, 1224 (2008).

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