Abstract Submitted
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Sub-critical crack growth in a sheet of paper[1] L. VANEL, S. SANTUCCI, N. MALLICK, P.-P. CORTET, S.G. ROUX, S. CILIBERTO, Laboratoire de Physique, ENS Lyon, France — We present experiments on the slow growth of a single crack in a fax paper sheet submitted to a constant force F. The non-averaged crack growth curves present a stepwise growth dynamics. Modelling the material as a lattice where the crack is pinned by elastic traps and grows due to thermal noise, we find that, in agreement with experiments, the distribution of step sizes follows subcritical point statistics with a power law (exponent 3/2) and a stress-dependent exponential cutoff diverging at the critical rupture threshold [1]. Taking into account the microstructure of cellulose fibers, the model is able to reproduce the shape of the statistically averaged crack growth curves, the dependence of the characteristic growth length on F as well as the effect of temperature on the rupture time. Finally, roughness of the crack interface is shown to depend on whether the crack grows in the subcritical regime, or in the rapid regime, over the critical rupture threshold. We analyze this roughness difference using a new approach based on the cumulants of the statistical distribution of the crack front height variations.
[1] S. Santucci, L. Vanel and S. Ciliberto, Phys. Rev. Lett. 93, 095505 (2004).

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