Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Theory of rate dependent fracture size effects ALESSANDRO TALONI, ALESSANDRO SELLERIO, STEFANO ZAPPERI, Center for Complexity and Biosystems - Physics Department, University of Milan La Statale" — The idea that the solid failure can be described by means of the Kramer theory, where the intrinsic energy barrier is reduced proportionally to the applied field, first appeared in material science to treat the kinetic fracture of solids under applied stresses and dates back to '40s. Most previous works focused on the thermal dependence of the average strength or the failure time in creep experiments and did not address the survival distribution and its size dependence. To this end, we start from recent theories developed for single-molecule pulling, where the molecule rate coefficient for rupture (or unbinding) is modified by the presence of an external time-dependent force, and we adjust it to a macroscopic elastic object. We generalize the extreme value theory to account for failures of materials with an explicit dependence on temperature, strain rate and size of the object. We show that in the limit of macroscopic objects, large strain rate and low temperature, thermal fluctuations are negligible and the usual extreme value theory is recovered. We provide the critical interpretation of several experiments in terms of our theory, furnishing a clearcut criterion for thermal effects to become relevant. [Phys. Rev. Applied , 024011]

Alessandro Taloni
Center for Complexity and Biosystems - Physics Department, University of Milan La Statale"

Date submitted: 04 Nov 2015 Electronic form version 1.4