Strain drop measurements for the study of avalanches in geomaterials and ferroics

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SiO_2-based porous materials (Vycor, Gelsil), charcoal, shale and schist have been measured under very slow uniaxial compression at low constant force rates using a Diamond DMA (Dynamical Mechanical Analyzer , Perkin Elmer) up to complete failure. The jerky evolution of the sample's height with time was analyzed in order to determine the corresponding power-law exponents for the maximum velocity distribution ($\mu \approx 2$), the energy (squared velocity-) distribution ($\varepsilon' \approx 1.5$) as well as the modified Omori's law ($p \approx 0.6$) of events [1]. These obtained power-law exponents are in good agreement with mean-field values. For charcoal we generally find lower values for the exponents μ and ε'. For charcoal a clear decay of aftershocks with $p \approx 0.6$ was observed, whereas for shale and schist results so far do now allow to draw a definite conclusion about the aftershock dynamics. The results show that the failure dynamics of materials can be well studied by measuring strain drops under slow compression, although the time resolution of the method needs to be improved.
Domain walls and twin boundaries represent another interesting system which can exhibit „crackling noise“. Recently avalanche type behaviour was shown for a single progressing needle domain in $LaAlO_3$ [2].
Here we show new results of two ferroelastic materials $LaAlO_3$ and $PbZrO_3$, where we studied the intermittent strain response of many needles to an externally applied force in the region of domain freezing [3].

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