Geophysical Research Abstracts,
Vol. 11, EGU2009-5953, 2009
EGU General Assembly 2009

Mechanisms of electromagnetic emission in plastically deformed ionic crystals

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Experiments on the plastic deformation of LiF ionic monocrystals under uniaxial compression are performed with simultaneous recording of acoustic AE and electromagnetic EME emissions. A strong correlation between AE and EME events has been found, which clearly demonstrates that the observed EME is caused by a dynamical interaction between moving dislocations and charged vacancies in the ionic lattice during work hardening. The mechanism proposed to explain EME is based on the assumption that gliding edge dislocations sweep up the vacancies of a preferable sign. As a result, when a dislocation pileup is formed, a certain nonequilibrium charge density is accumulated at its head, resulting in electric polarization of the deformed crystal. As the external loading increases, a locked dislocation pileup bursts through the stoppers and quickly loses its bounded charge. The relaxation of this charge produces an intrinsic polarization current generating an electric pulse. The aformentioned proposed mechanism may be confirmed by the following experimental result: gamma-irradiated ionic crystals, by Co60, that are subjected to compression until failure, do not emit electromagnetic signals. A plausible explanation of this fact is proposed in this presentation.