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Pressure Stimulated Currents (PSC) technique: A review

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Weak electric currents appear when brittle materials are subjected to mechanical stress of various modes. The Pressure Stimulated Currents technique has been introduced to investigate the underlying physical mechanisms that dominate this phenomenon. A potential theoretical model which is known as Moving Charged Dislocations model is evaluated using the Pressure Stimulated Currents technique. According to this model the emitted electric currents are directly related to the imperfections in the bulk of the material that either pre-exist or are created and develop due to the externally applied stress.

In this work an attempt is made to summarize the experimental results and the conclusions of the Pressure Stimulated Currents technique which has been applied to a collection of brittle materials like marble and amphibolite and construction materials like cement paste and mortar. The electric current is recorded in three bounded stress ranges while stress is applied in different modes. The first range is limited to stress levels low enough to be inadequate to create significant bulk damages. In the second range the applied stress is adequate to create damages in bulk of the material. The third range is in the vicinity of fracture. The form and the magnitude of the recorded electric current vary depending on the level of the applied stress.

The experimental results manifest a strong relation of the electric current to both the applied stress and stress rate as well as on the yielded strain. When the Young's modulus of the material becomes smaller due to the significant irreversible damage processes the weak electric current recordings become intense and a linear relation between the released electric charge and the mechanical strain is observed. In the vicinity of fracture, the form of the emitted current is characteristic and it is related to the mode of fracture of the sample while deviations from the linearity are observed.

The Pressure Stimulated Currents technique can give a very useful bundle of information about the health of the material sample for each stage of mechanical stress. If appropriate predetermined mechanical triggering is applied through the stress application, this technique can prove to be a fine method for the evaluation of the damages magnitude in a sample. Furthermore the experimental results describe a solid ground that could interpret observed preseismic electric signals.