On the Origin of Discontinuous Plastic Flow in Austenitic Steels: An Acoustic Emission Study

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Austenitic steels subjected to cryogenic tensile loading may exhibit discontinuous plastic flow (DPF) below temperature T_0,[2] visible as serrations in stress-strain response [1,2]. Acoustic emission (AE) provides a complementary in-situ tool for tracking intermittent plastic activity associated with this instability [3]. In this study, cryogenic tensile tests of 304, 316L and N50 austenitic steels were performed with simultaneous monitoring of stress response and AE activity investigated on site shown on Fig. 1.

Particular attention was paid to individual serration events and to short time intervals containing one or two serrations, analyzed together with the corresponding stress response. Full-record AE representations were complemented by selected interval-based time-frequency plots in order to resolve local changes in signal organization associated with isolated discontinuities of plastic flow [3]. The results indicate that AE signal evolution correlates with the stress response and enables identification of successive stages of DPF [4] and give an ability to predict its occurrence.

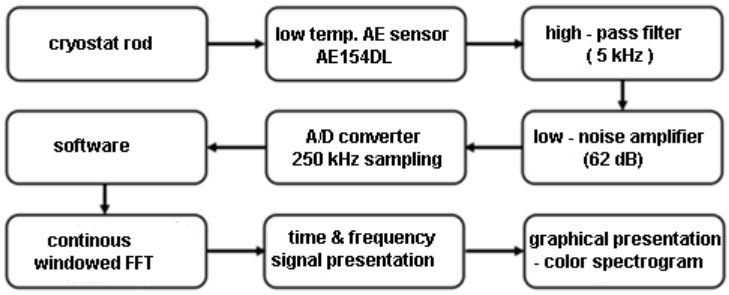

Figure 1. Acoustic emission (AE) signal acquisition and processing workflow used in cryogenic tensile tests.

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