Analyzing the phase transformation intermittency in a shape memory alloy using the grid method

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Abstract:

The objective of this study is to experimentally evidence the intermittency of the phase transformation occurring in a shape-memory alloy using a full-field measurement technique, namely the grid method. The specimen is a copper-based single crystal which is austenitic at ambient temperature. A uniaxial tensile loading is applied using a device based on gravity, in practice a drop-by-drop device controlled by water pumps enabling us to apply a perfectly monotonic loading with very small force increments. The grid method was used to measure the strain fields on the specimen surface during the test. It is observed that the plateau which is classically observed when the specimen transforms from austenite to martensite is actually characterized by an intermittency of the phase change. We characterize the strain intermittency in a number of ways, showing the emergence of power-law behavior for the strain avalanching. We also describe the asymmetry observed in the forward versus reverse transformation. The present experimental approach, which allows for the monitoring of the reversible martensitic transformation both locally and globally in the crystal, proves useful and enhances our capabilities in the analysis and possible control of transition-related phenomena in shape-memory alloy [1].

[1] X. Balandraud, N. Barrera, P. Biscari, M. Grédiac, G. Zanzotto, Strain intermittency in shape-memory alloys, Physical Review B 91, 174111-11, 2015