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Field analysis of energy conversion during plastic deformation process

Sandra Musiał[a], Michał Maj[a], Leszek Urbański[a], Marcin Nowak[a]

[a]*Institute of Fundamental Technological Research Polish Academy of Sciences*

smusial@ippt.pan.pl

The paper presents a new experimental approach to analyze energy conversion process during uniaxial tension of the 310S austenitic steel. The distribution of plastic work was determined based on the displacement field obtained using digital image correlation (DIC) technique and the developed DIC-based stress determination method [1]. The distribution of energy dissipated as heat was based on the temperature fields obtained using infrared thermography (IRT) and transient heat conduction equation [2]. As a measure of the energy conversion the energy storage rate *Z* was used. Just before the end of the process the *Z* values decreased significantly and became close to 0 or even negative, which means that the material lost its ability to store the energy. Additionally, the crystallographic orientation maps obtained based on the electron backscatter diffraction (EBSD) analysis for subsequent stages of the process showed that material's microstructure evolves towards two dominant texture components.

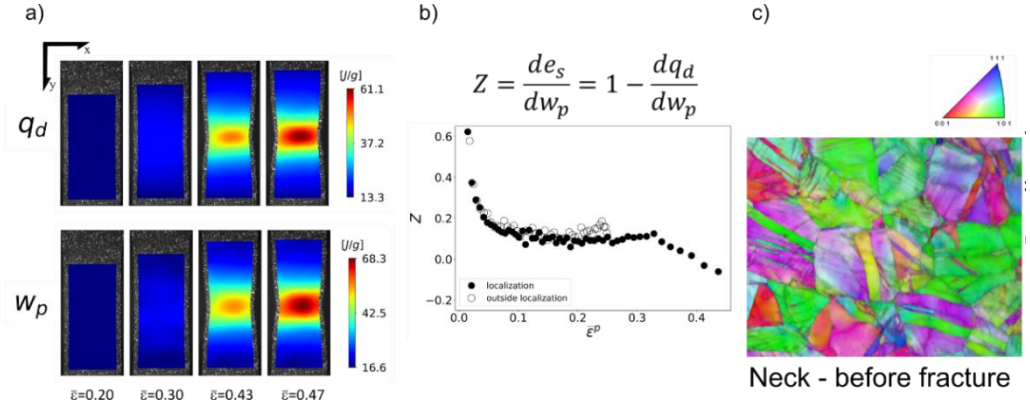

Fig. 1. The evolutions of the q_d and w_p a), the energy storage rate b) and corresponding orientation map in necking area c).

Keywords: Digital image correlation, Infrared thermography, Energy conversion, Heat sources, Transient heat conduction equation.

References:

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[2] S. Musiał, M. Maj, L. Urbański, M. Nowak. Field analysis of energy conversion plastic deformation of 310S stainless steel, Int J Solids Struct, 238 (2022), 111411.