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# Ductility and toughness of a 7 GPa pearlitic steel

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Heavily cold drawn pearlitic steel wires with a structural size of below 10 nm belong to the currently strongest bulk materials available. This severe refinement is accompanied by a transformation of the initial dual-phase lamellar composite to a single-phase nanograined structure with carbon decorated subgrain boundaries. These structural changes do not only induce a tremendous increase of strength, but also affect ductility [1] and toughness [2]. By comparing mechanical properties of high pressure torsion deformed pearlitic steels consisting still of the nanolamellar structure [3] to those with a nanograined structure, the impact of the architecture was deduced using in-situ microbending experiments. Static and cyclic loading conditions on pristine and pre-notched samples were applied to elucidate differences in the deformation behavior, as well as to study crack initiation and propagation. The nanolamellar architecture can be bent homogeneously to higher plastic strains compared to the nanograined structure where strain localization by shear banding promotes earlier failure. Similarly, upon quasi-static fracture but also under fatigue loading the nanolamellar structure allows for a considerably larger toughness or prolonged lifetime. This indicates the importance of the architecture for the mechanical performance of nanocomposite structures.

*Keywords: nanocomposite, micromechanics, strain localization, high pressure torsion, wire drawing*

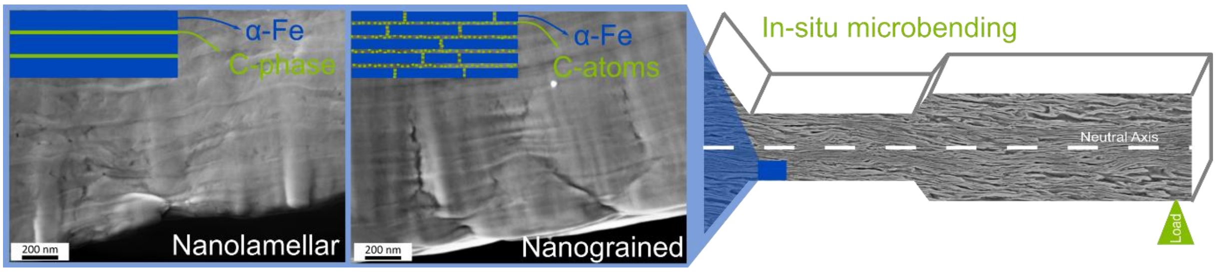


Fig.1 SEM images revealing the different deformation characteristics of a HPT deformed nanolamellar and a cold drawn nanograined pearlitic steel.

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