ICSMA19 Metz, France, June 26 - July 1, 2022
International Conference on Strength of Materials

Anisotropic strengthening in nanolamellar pearlitic steel

Pradipta Ghosh[a], Surendra Kumar Makineni[b], Ulrich Lienert[c], Reinhard Pippan[d]

[a]*Indian Institute of Technology Gandhinagar, Gujarat, India*

[b]*Indian Institute of Science, Bangalore, India*

[c]*Deutsches Electronen-Synchrotron, Hamburg, Germany*

[d]*Erich Schmid Institute of Materials Science, Leoben, Austria*

Nanolamellar pearlitic steel has attracted lot of attention due to its exceptional strength [1] and anisotropic facture toughness [2]. Such combination of strength and toughness has been attributed to the nanometer length scale of the ferrite channels which are the primary carriers of dislocation plasticity. Moreover, it was observed that the severe deformation used to synthesize this material disintegrates the hard cementite and enriches the ferrite matrix with carbon atoms. This increase in solute content also contributes to the strengthening of ferrite channels.

In addition to these strengthening mechanisms, it was also observed that the confined layer deformation of ferrite lamellae leads to anisotropic strengthening with the strength of lamellae loaded perpendicularly being higher than the lamellae loaded at inclination [3, 4]. In the present work we investigated the strength anisotropy in high pressure torsion deformed pearlitic steel. In depth microscopy and composition analysis is performed to understand the role of deformation and lamellae size on strengthening mechanisms.

Keywords - Nanolamellar, anisotropy, strengthening, pearlite

References

[1] Y Li et al., Segregation stabilizes nanocrystalline bulk steel with near theoretical strength, Phy. Rev. Lett., 113 (2014) 106104

[2] A. Hohenwarter et al., Effect of large shear deformations on the fracture behaviour of a fully pearlitic steel, Metall. Mater. Trans. A, 42 (2011) 1609-1618

[3] MW Kapp et al., Anisotropic deformation characteristics of an ultrafine and nanolamellar pearlitic steel, Acta Mater., 106 (2016) 239-248

[4] Ghosh et al., Deformation characteristics of ultrafine grained and nanocrystalline iron and pearlitic steel – An in situ synchrotron investigation, Acta Mater., 160 (2018) 22-33