ME Seminar

Deformation, phase transformation and fracture micro-mechanisms of steels

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ABSTRACT

Metastable austenite undergoes deformation-induced martensitic transformation which enhances work-hardening and ductility. This presentation focuses on understanding of: (a) martensitic transformation and (b) ductile fracture micro-mechanisms of the steel. Many studies monitoring the formation of martensite during tensile-deformation of austenite report data which are, in principle, affected by both applied stress and resulting plastic-strain. It is not clear whether the transformation is stress-induced (i.e., stress provides a mechanical driving force) or whether the generation of defects during deformation helps nucleate martensite in a scenario better described as strain-induced transformation. It is demonstrated that a large volume of published data relating the martensite-fraction to plastic-strain can in fact be explained in terms of pure thermodynamic effect of applied stress. Influence of stress has also been determined by crystallographic variant selection. This will be useful in understanding the ductile fracture micro-mechanisms. Ductile fracture micro-mechanisms are well established. It is believed that the structure drives the properties in materials. However, evidences to prove this relation is not often convincing and a direct confirmation w.r.t. fracture properties is always desirable. Correlation of fracture-features to mechanical properties has been demonstrated for steels and other alloys. The technique provides a method for direct determination of mechanical properties from fracture-features.

ABOUT THE SPEAKER

Dr. Arpan Das received B.E. (Metallurgical Engineering) from Jadavpur University (JU) during 1998-2002; M.Tech (Metallurgical and Materials Engineering) from IIT Madras during 2002-2004 and Ph.D. (Engineering) from JU during 2006-2013. He worked as a Scientist Fellow at CSIR-NML Jamshedpur during 2004-2006. Subsequently, he worked there as a `Scientist' (permanent, different levels) during 2006-2014. He worked as a BOYSCAST Fellow (GOI) with Professor Sir H.K.D.H. Bhadeshia at University of Cambridge, UK during 2009-2010. He also worked as a KSKRA Fellow at BARC, Mumbai during 2014-2016. Currently, he has been working there as a `Scientific Officer E' since 2016. His research includes: martensitic transformation, deformation and fatigue-fracture micro-mechanisms of steels and application of machine learning. He has published 65 articles in different international journals. He is the recipient of different awards/recognitions. Like: Young Metallurgist of the Year Award, The Young Engineers Award, KSKRA (BRNS), BOYSCAST (GOI), JRF (DRDO) fellowships and many others. Recently, his name was featured among top 2% scientists in the world as per Stanford University list (2020-2023). He has been participating actively in reviewing articles in different journals. He is also a member of different scientific societies (IIM, EMSI, INS etc.). He also handled different projects (i.e., funded by TATA STEEL, GE, BRNS, CSIR, BARC, IGCAR, AIR FORCE etc.) as PI, Co-PI and members.

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