# The Role of Plastic Strain on Microstructural Evolution in Bainitic Steel During Uniaxial Hot Compression Test: Experiment and Finite Element Simulation

Mahdi Karamabian*[1], Pedram Parandavar[1], Mingming Tong[1,2], and Seán Leen[1,2,3]

[1]Mechanical Engineering, College of Science and Engineering, University of Galway, Ireland – Ireland
[2]I-Form Advanced Manufacturing Research Centre, Ireland. – Ireland
[3]Ryan Institute for Environmental, Marine and Energy Research, University of Galway – Ireland

**Abstract**

The consequence of plastic strain on the hot deformation behaviour and grain size evolution in bainitic steel was investigated using Gleeble thermo-mechanical physical simulation and finite element simulation. The model was validated by comparing the predictions with the experimentally measured true stress-strain curves. The model allowed quantification of the heterogeneity of plastic strain within the uniaxial hot compression test specimens under the investigated conditions. The results reveal that increasing plastic strain enhances dislocation density, promoting the nucleation of recrystallized grains. The recrystallized grain size decreases with higher strain due to enhanced grain boundary migration and subdivision of grains, reaching a saturation grain size at large plastic strains. This behaviour is modelled using an Avrami-type equation, which incorporates the fraction of recrystallized grains. The maximum plastic strain was mainly observed at the centre of the sample and the minimum occurred in the so-called dead zones close to the platen. The inhomogeneous distributions of plastic strain resulted in an inhomogeneous final microstructure, *i.e.,* inhomogeneous distribution of recrystallization, constituent fraction, and average grain size.

*Speaker