Application of Advanced Experimental Techniques to Enhance Understanding of Mechanical Behavior of Steels

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There has been a significant interest in the design of new high strength steels with complex microstructures and the manipulation of their properties at the nanoscale. During different stages of steel processing and in-service, changes occur not only at micro scale, but also at the atomic level. The latter ones could be the key factors controlling the mechanical properties and behaviour of steels. Thus, understanding the effects of alloying additions on the nanoscale level is essential for tailoring the steel composition and properties for a specific product requirement.

Development of modern characterisation techniques, such as atom probe tomography and high resolution scanning transmission electron microscopy opened pathways for nanoscale analysis. These powerful techniques have been used for the direct experimental observations of early stages of phase transformations, clustering, fine precipitation, atmospheres around dislocations and segregation at interfaces. In addition, both correlative microscopy and/or combination of several techniques approaches provide a useful tool for obtaining a complete picture of material at different levels.

In this talk, the examples of understanding the mechanical behavior of steels based on the key evidence provided by atom probe tomography will be presented. The bake hardening and retained austenite stability of transformation-induced plasticity steel, as well as ageing behavior of maraging steel, will be addressed.