National Institute of Technology Rourkela

Departmental Seminar

Seminar Title	: Improvement in Surface Characteristics by Ultrafast Heating of Severely Deformed Low Carbon Low Alloy Steel
Speaker	: Prakash G. Ranaware
Supervisor	: 9834826938
Venue	: M.Tech class room (MM 202E), MM Annex building
Date and Time	: 29 Jan 2025 (5:00 PM)
Abstract	: Ultrafast heating (UFH) of low carbon low alloy steel with and without cold working has shown enhancement in mechanical strength along with ductility and toughness of these steels. The application of ultrafast heating restrict macro diffusion, can influence phase transformations and leads to grain refinement. This rapid thermal treatment technique has been successfully applied on sheets and tubes to derive a range of refined and mixed phase microstructures (such as mixture of ferrite, bainite and martensite) and superior mechanical properties. UFH influences not only the microstructure but the texture of the cold rolled steel. For cold worked steel, due to rapid heating, a very strong interaction between the ferrite phase recrystallization and the austenite phase formation is observed and thus the kinetics of austenite phase formation is influenced which includes morphology and spatial distribution of bainitic and martensitic phases. UFH allows recrystallization to be partially or completely suppressed, and the crystallographic texture after UFH remains almost the same as the texture before the UFH treatment. Although considerable amount of research has been carried on effect of UFH on cold worked steel, the effect of UFH on severely deformed cold work steel is not yet reported. The objective of this research work was to study effect of ultrafast heating on severely deformed low carbon low alloy steel. Low carbon low alloy steel AISI8620 was used in this work. Shot peening method was employed to obtain severely deform steel surface and laser heating technique was used to achieve ultrafast heating. Laser heating technique is an established efficient technique of surface transformation hardening which is used for synthesizing a hard, wear resistant surface layer on parts through the ultrafast heating action of the high energy scanned laser beam. Initial microstructure plays a very significant role on nucleation and growth kinetics of austenite formation during ultrafast heating of laser treatment. In this work, initial microstructure was achieved through hardening and tempering treatment. Three different tempered structures were used as initial microstructure in this work. Laser heating was carried out with heating rate in the range of 200oC/s to 285oC/s on shot peened specimens as well as on un-shot peened specimens for comparison. After the treatments, steel specimens were characterized through XRD, optical microscopy, SEM, TEM and micro-hardness testing. As compared to un-shot peened specimens, it was observed that surface hardness increased by 20 % for shot peened specimens after ultrafast heating treatment. The hardened layer thickness increased by 22 % compared to un-shot peened specimens at identical conditions of UFH. Microstructure after UFH of shot peened specimens shows more refined features of lath martensitic structure compared UFH of un-shot peened specimens. Prior austenite grain size decrease from 7.72 μm to 6.56 μm and lath packet size reduces from 7.36 μm to 5.88 μm for shot peened specimen as compare to un-shot peened specimen. Mechanism of grain refinement due to SPD before UFH is proposed. Keywords: Low carbon low alloy steel, ultrafast heating, severe plastic deformation