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Correlation of Microstructure with Mechanical Properties of Ti Containing Fe-7Al-0.35C Based Lightweight Steel

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ABSTRACT

Lightweight steels are gaining extreme importance as these steels offer higher strength with lower density. Strength improvement by 200 MPa and 10% reduction in density is achieved by addition of 7wt.%Al to steels. These steels find enormous application in land based transportation for defence and civilian application. They can minimize the gasoline consumption and improve the green house effect. The effect of Ti(0.2-1.0wt.%) on the in-situ formation of carbides and its impact on the mechanical properties of Fe-7Al-0.35C based steel is investigated . The volume fraction and the types of phases of the alloy is predicted by Thermo-Calc software which is compared by the experimental work. Pancakes of about 10 mm thickness were prepared by vacuum arc melting process, subsequently these samples were hot-rolled to 2mm and characterised. Microstructure reveals the presence of TiC precipitates (dark cubidol and dark acicular) along with grey needle shaped κ-carbide precipitate in ferrite matrix. The strength increment is due to the formation of very fine hard TiC precipitates and the ductility increment is due to grain refinement. The fractography studies of the tensile tested sample surface of 0.2 wt.% Ti alloy exhibited transgranular cleavage fracture feature which tends to mixed mode fracture with smaller cleavage lengths at higher Ti content due to grain refinement.

Keywords: Lightweight steel, Thermo-Calc, TiC, Fe-7Al-0.35C alloy