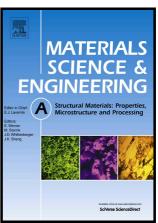
## Author's Accepted Manuscript

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ACCEPTED MANUSCRI

Strengthening mechanisms in Fe-Al based ferritic low-density steels

<sup>a</sup>Sudipta Pramanik, <sup>b</sup>Koppoju Suresh, <sup>c</sup>Anupama A V, <sup>c</sup>Balaram Sahoo, <sup>\*a</sup>Satyam Suwas

<sup>a</sup>Department of Materials Engineering, Indian Institute of Science, Bangalore, India-560012

bInternational Advanced Research Center for Powder Metallurgy and New Materials,

Hyderabad, India-500005

cMaterials Research Centre, Indian Institute of Science, Bangalore, India-560012

Abstract

Low-density steels with different aluminium contents have been investigated with an aim

to examine the occurrence of different strengthening mechanisms leading to its higher

strength. A composition corresponding to 6.8 wt.% aluminium has been studied to

understand the underlying strengthening mechanisms. Different factors contributing to the

strengthening mechanisms have been separately analyzed. Microstructural features have

been analyzed using Mössbauer spectroscopy, small angle X-ray scattering (SAXS), X-ray

line profile analysis and transmission electron microscopy (TEM). The enhanced yield

strength of the low-density steel containing 6.8 wt.% Al was attributed to the strengthening

effects arising from the ferrite grain size, dislocations incorporated during processing,

ordered phase formation and the presence of Al atoms in the solid solution. Each of these

operating mechanisms was modelled by using its constitutive equation for example, grain

size strengthening by classical Hall-Petch equation and the strengthening from dislocations

by Taylor's equation. In addition, the formation of nano-sized ordered phase was evaluated

by TEM, Mössbauer spectroscopy, SAXS and hence order strengthening was modelled by

using the size and volume fraction (as determined by TEM and SAXS). Strengthening due to

lattice frictional stress required for dislocation motion was also incorporated into the

model.

**Keywords:** Low-density steel, Strengthening mechanisms, Mössbauer spectroscopy, Small

angle X-Ray scattering (SAXS)

\*Corresponding author

Email address: satyamsuwas@materials.iisc.ernet.in (Satyam Suwas)

Tele: +91-(0) 80-2293 3245 (Office)

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