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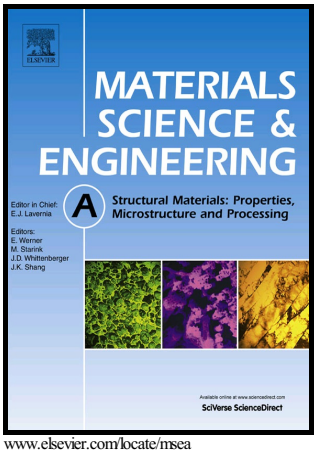


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# Strengthening mechanisms in Fe-Al based ferritic low-density steels

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## 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)

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