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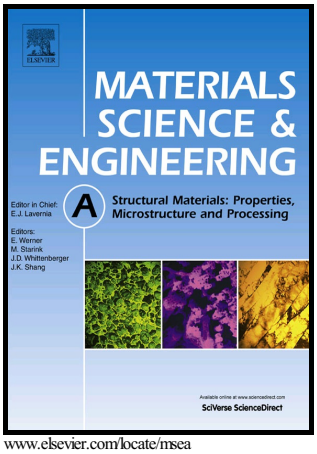


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# Identification of the role of Al-Fe-Mn-Si large casting dispersoids in age-hardenable aluminum alloys using small angle X-ray scattering

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## Abstract

Aluminum flat-stock incorporates large dispersoids to facilitate grain-size refinement upon casting and to prevent galling in downstream operation. Industrial-practice has reduced the deleterious effects of stringers and the focus for cost-effective Al-Mg-Si alloys has been the characterization of nano-precipitates to attain optimum strength conditions. Such studies record the presence of large intermetallic particles but their role during work-hardening is ignored. Constitutive relation analyses (CRA) which can replicate the stress-strain diagram have revealed that parabolic hardening beyond yield point elongation is due to these particles. At maximum matrix strengthening by artificial ageing, the enforced strains around these non-shearable µm-sized particles are accommodated by rotated structures; that is, dislocation arrays leading to increased strain hardening. The spreading of lattice orientations due to these events enhance the occurrence of double Bragg scattering (DBS) detected by small angle X-ray scattering (SAXS). Separating the anisotropic SAXS intensity from the total intensity, the role of layered precipitates can be differentiated from that of DBS by comparing data from the undeformed grip to that from the deformed gauge section of tensile specimens aged for various times. Although the presence of layered precipitates will be similar for grip and gauge sections, the lattice rotation inherent during deformation may alter the SAXS response. Moreover the variation of anisotropic SAXS data (streaking) with artificial ageing times is attributed to the evolution of epitaxial nano-precipitation on the dispersoids interfaces.



Keywords: aluminum; constituent; age-hardening; small-angle x-ray scattering; electron microscopy; deformation

## 1. Introduction

In the casting of aluminum (Al) alloys, intermetallic precipitate based on iron (Fe) are inherent during solidification due to the inevitable presence of Fe in bauxite. The occurrence of these large particles are used to advantage for reducing grain size during casting and their subsequent role in preventing galling during hot and cold rolling. To clarify the terminology of