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Elena V. Pereloma, Fayeze Al-Harbi, Azdiar A. Gazder

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The crystallography of carbide-free bainites in thermo-mechanically processed low Si transformation-induced plasticity steels

Elena V. Pereloma^{1,2}, Fayez Al-Harbi¹, Azdiar A. Gazder^{2*}

¹ School of Mechanical, Materials and Mechatronic Engineering, University of Wollongong, New South Wales 2522, Australia

² Electron Microscopy Centre, University of Wollongong, New South Wales 2500, Australia

Abstract

Carbide-free bainites are important microstructural constituents in bainitic, nanobainitic and transformation-induced plasticity (TRIP) steels. A comparison of the crystallography of granular bainite and bainitic ferrite morphologies, both of which were simultaneously present in a base and a Nb-Ti containing TRIP steel, has been carried out using electron back-scattering diffraction. Granular bainite was characterised by the realisation of nearly all 24 variants of the Kurdjumov-Sachs orientation relationship; which in turn was associated with the self-accommodation of the transformation strain. On the other hand, bainitic ferrite comprised a mostly parallel lath structure between thick interlayers of retained austenite and exhibited variant selection such that one or more crystallographic packets are not realised and sometimes only 1-2 variants formed in a crystallographic packet. The variant selection in bainitic ferrite was associated with (i) the plastic accommodation of transformation strain by the retained austenite and, (ii) the limited available volume for its formation.

Keywords: transformation induced plasticity (TRIP); steel; electron back-scattering diffraction (EBSD); bainite transformation; Kurdjumov-Sachs orientation relationship

* Corresponding author: **Azdiar A. Gazder**

Phone: +61 2 4221 5904

Fax: +61 2 4221 3114

e-mail: azdiar@uow.edu.au

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