Relationship between grain size and shape in normal grain growth; A phase-field study

Reza Darvishi Kamachali, Ingo Steinbach

reza.darvishi@rub.de

ICAMS, Ruhr-University Bochum, 44780 Bochum, Germany

3D phase-field simulations of normal grain growth are investigated from topological and statistical perspectives [1]. Starting from a uniform distribution, a self-similar grain size distribution has been observed which differs from mean field prediction [2]. The distribution of topological classes, as characterized by the number of facets per grain, is found to be time-invariant and, it is in good agreement with analytical derivation [3] and previous simulation studies [4]. The volumetric growth rate per topological class also correlates well with the analytical expression obtained by Mullins [5]. The relationship between size and shape of the grains uncovers the existence of a geometrical drag imposed by mobile triple junctions. Our studies suggest a modified kinetic equation for steady-state normal grain growth.

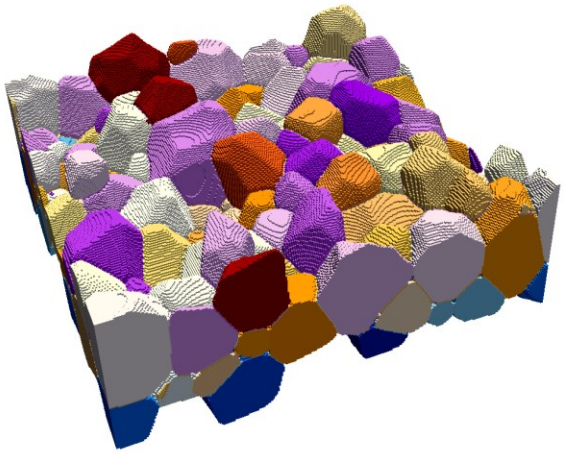

Figure 1: A snapshot of simulation box. Colour coding presents phase-field indices of grains.

[1] Darvishi Kamachali R, Steinbach I. Act Mater 2012;60:2719.

[2] Hillert M. Act Metall 1956;13:227.

[3] Rios PR, Glicksman ME. Act Mater 2008;56:1165.

[4] Lazar EA, Mason JK, MacPherson RD, Srolovitz DJ. Act Mater 2011;59:6837.

[5] Mullins WW. Act Mater 1956;3:900.