

Thermodynamic optimization of the Al-C-Mg system

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Résumé :

Grain refinement of Mg-Al based alloys is challenging because it is known that Zr, which is extremely effective in many Al-free alloys, cannot be used. The addition of carbon through various routes by using carbon-containing sources is considered as an option through the precipitation of a fine carbide phase acting as a nucleant for alpha-Mg grains. The nature of the carbide phase and, thus, the grain refinement mechanisms, are still under debate, mainly because of the lack of data concerning the Al-C-Mg ternary system. The present work is focused on the thermodynamic assessment of the ternary base system Al-C-Mg, including the potential nucleants Al_4C_3 and Al_2MgC_2 , presently without consideration of Al_2CO .

The decomposition temperatures of the Al_4C_3 and Al_2MgC_2 carbides were determined experimentally and their heats of formation computed by ab-initio methods. A complete thermodynamic description of the Al-C-Mg system is being conducted based on those results including the significant Mg content present in solid solution in the Al_4C_3 phase. This description is supported by ternary key experiments and also includes a reassessed Al-C system.