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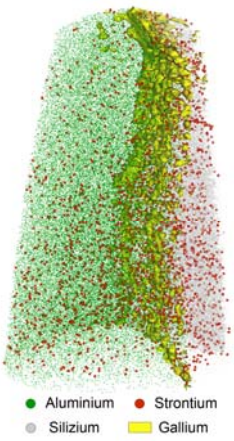
Erasmus Mundus

DocMASE Project Proposal 2012-04

Project Title	***3D Microstructure characterization: Strontium distribution in AlSi- Alloys***
Main University and Advisor	**Saarland University** (Saarbrücken, GERMANY) Prof. Frank MÜCKLICH
Second Univ. and Advisor	**Linköping University** (Linköping, SWEDEN) Prof. Magnus ODEN
Associated Partner(s)	**SECO Tools** (SWEDEN) Prof. Bo JAHNSSON, **INM** (Saarbrücken, Germany)
Project Description	Al-Si casting alloys are of great industrial importance. The addition of trace elements, Sr being the most commonly commercially used, causes a flake-to-fibrous transition which contributes to the improvement of tensile, impact and thermal shock properties[1]. Three-dimensional analyses done by focused ion beam (FIB) tomography confirm the significant changes in the silicon morphology resulting from this modification[4,5,6]. In order to obtain a better understanding of the underlying mechanisms occurring during modification, a deep analysis of the modifier element distribution is essential. However, low Sr concentrations used for this purpose (commonly between 50 and 400 ppm) are below the detection limit of several spatially resolved chemical characterization methods. The aim of this project is to characterize the Sr distribution in hypoeutectic Al-Si alloys with resolutions down to the atomic scale. The combination of *atom probe tomography* (APT)[2] and *transmission electron microscopy* (TEM) is a powerful tool to obtain correlative results between chemical composition and structural analysis. On top of that, these experimental results will be accompanied by the use of *first-principles density-functional theory* (DFT) simulations.  The experimental part including APT analysis and TEM will be carried out at the University of Saarland, while DFT simultation will take place at the University of Linköping. Previous experience in the use of atom probe, focused ion beam (sample preparation) and transmission electron microscopy will be of advantage.
References	[1] J.E. Gruzleski, B. Closset: Treatment of Liquid Aluminium-Silicon Alloys; *American Foundry Society*, 1990. [2] M. K. Miller. Atom probe tomography: analysis at the atomic level. *Kluwer Academic/Plenum publishers, New York,* 2000 [3] M. De Graef. Introductrion to Conventional Transimission Electron Microscopy.*Cambridge*
Previous Publications	[4] F. Lasagni, A. Lasagni, C. Holzapfel, F. Mücklich, H. P. Degischer: Three Dimensional Characterization of Unmodified and Sr-Modified Al-Si Eutectics by FIB and FIB EDX Tomography; *Advanced Engineering Materials* **8** (2006) 719-723. [5] F. Lasagni, A. Lasagni, E. Marks, C. Holzapfel, F. Mücklich, H.P. Degischer: Three Dimensional Characterization of As-cast and Solution-treated AlSi12(Sr) Alloys by High-resolution FIB Tomography; *Acta Materialia* **55** (2007) 3875-3882. [6] F. Lasagni, A. Lasagni, M. Engstler, H.P. Degischer, F. Mücklich: Nano-characterization of Cast Structures by FIB-Tomography; *Advanced Engineering Materials*, **10** (2008) 62-66.