11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

Extreme Large-scale Multi-Phase-Field Simulation of Polycrystalline Grain Growth using TSUBAME2.5 GPU-Supercomputer

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Key Words: *Multi-Phase-Field Method, Grain Growth, GPU Computing, Large-scale Simulation.*

Recently, the multi-phase-field (MPF) method has attracted much attention as the most promising technique for numerical modelling of microstructure evolution in polycrystalline materials [1]. The MPF method has already been applied to computer simulation of microstructure evolutions during solidification, recrystallization and phase transformation [2]. However, since multiple time-evolution equations of order parameters (phase field variables) must be solved, very high computational cost is often required in order to perform realistic three-dimensional (3D) MPF simulation. In the previous studies, parallel computing of the MPF simulation using multiple CPU cores and message passing interface (MPI) library [3]. On the other hand, recently, graphics processing unit (GPU) which was originally developed as a hardware used for high-speed graphics rendering has been widely applied to accelerate scientific computing. Recently, we have developed very high-speed and efficient computing technique for large-scale 3D MPF simulation using multiple GPUs [4]. In this study, our multiple-GPU computing technique was implemented on TSUBAME2.5 GPU-supercomputer of Tokyo Institute of Technology in order to perform extreme large-scale 3D MPF simulation of polycrystalline grain growth.

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