Poster Session | A. Advances in Materials Theory for Multiscale Modeling

[PO-A1]Poster Session 1

Symposium A

Mon. Oct 29, 2018 5:45 PM - 8:00 PM Poster Hall

[P1-04]Isogeometric modeling and large-scale computation for stress field around lattice defects

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It is well known that classical elasticity yields singular stress field around the core of lattice defects such as point defects and dislocations. Regularization of the stress singularity is therefore primarily important to understand mechanical behavior of defects from a continuum viewpoint. First strain gradient elasticity (FSGE) generalizes the classical elasticity by introducing the characteristic length l in the constitutive equation. Recent theoretical investigations revealed that FSGE removes the stress singularity at the core of dislocations and disclinations. Hence, the *non-local* elasticity theory is suitable for multiscale modeling of defects in solid. In the present study, we aim to develop (i) isogeometric models for lattice defects and (ii) their numerical implementation for large-scale computation within the framework of FSGE. At first, we derive the weak form stress equilibrium equation for Cauchy-type FSGE. The integrodifferential Euler-Lagrange equation is then solved numerically using isogeometric analysis (IGA), *i.e.*, Galerkin method with the non-uniform rational B-spline (NURBS) basis functions. Consequently, the boundary value problem is cast into a system of linear algebraic equations whose degree of freedom exceeds 20 million. The large-scale computation was conducted on a supercomputer OCTOPUS which is installed in the cyber media center of Osaka Univ. Point defects were modeled using the first-order approximation for the force dipole and implemented into the weak form equation through the body force. The resulting stress fields showed singularity free distribution and they converged to classical solution with increasing in distance from the core. Dislocation model was constructed referring to the extended finite element method (XFEM). This model successfully reproduces the kink deformation from the pairs of equally arrayed edge dislocations.