Abstract - In type-II superconductor, energy dissipation is associated with the motion of vortex lattice in a form of vortex flow or creep. This dissipation is reduced by the presence of crystalline defects, namely “pinning”. An important technological challenge in application of type-II superconductors is increasing \( J_c \) under magnetic field. Epitaxial YBCO films having compound defects such as continuously developed BaZrO\(_3\) (BZO) and BaSnO\(_3\) (BSO) nanorods parallel to the c-axis of the films show the c-axis correlated, Bose-glass behavior. Significant enhancement of irreversibility field \( B_{irr}(T) \) and critical current density \( J_c \) is also observed particularly when magnetic field is applied parallel to the c-axis of the films (B \( \parallel \) c).

Firstly, in this presentation, the present situation of vortex pinning technology in YBCO superconducting films is reviewed, especially focusing on a new approach of hybrid APC technique. The detailed particular of the depinning of vortices from the pinned state are complex, involving the non-equilibrium dynamics of an elastic lattice through a disordered medium. Numerical simulation study of vortex dynamics by solving the time-dependent Ginzburg-Landau (TDGL) equations, where the vortex-vortex and vortex-pinning interactions are completely characterized, is effective approach to reliably describe the details of complex pinning-depinning transition. Secondary, we demonstrated the use of the method by solving a fully three dimensional problem of a current carrying superconductors with columnar defects such as nanorods under the tilting magnetic fields. The complex pinning-depinning transition in the vicinity of nanorods will be visualized based on the TDGL calculation.

Keywords (Index Terms) - YBCO coated conductors, artificial pinning centers, vortex pinning and motion, time-dependent Ginzburg-Landau equations.