Abstract - (RE)-Ba-Cu-O [(RE)BCO, where RE = rare earth element such as Y, Nd, Sm, Eu, Gd, etc.] high temperature superconductors (HTS) have significant potential for high field engineering applications at 77 K when fabricated in the form of large single grains by the so-called top seeded melt growth process (TSMG). A novel Y$_2$Ba$_4$CuMO$_y$ (Y-2411, where M = U, Zr, Hf, Nb, Ta, W and Mo) phase that is effective at pinning magnetic flux quanta in bulk (RE)BCO HTS on the nm scale has been developed recently at Cambridge with a number of desirable properties, including crystallographic compatibility with the superconducting (RE)Ba$_2$Cu$_3$O$_7$ (RE-123) phase, chemical stability at the melt processing temperature and an ability to resist coarsening during the melt process. This novel phase, which is more effective at pinning flux than the RE$_2$BaCuO$_5$ (RE-211) phase produced as a by-product of the melt growth process, has been used to the development a practical processing method for the fabrication in air of large, single grain RE-Ba-Cu-O superconductors. The process also includes a new type of generic seed crystal (Mg-doped NdBCO) that can promote effectively the epitaxial nucleation of any (RE)-Ba-Cu-O system and secondly by suppressing the formation of (RE)/Ba solid solution in a controlled manner within large (RE)BCO grains processed in air. This process has enabled fabrication of single grain samples of GdBCO that exhibit a record trapped field of 17.6 T at 26 K [1]. The recent development of multi-seeding techniques for the fabrication of larger sample of conformal geometry has improved further the prospects of these technologically important materials for practical applications, which will also be presented.


Keywords (Index Terms) - (RE)-Ba-Cu-O bulk HTS, top seeded melt growth process, Y$_2$Ba$_4$CuMO$_y$ pinning centers, record trapped field.