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Large critical current densities and pinning forces in CSD YxGd1-xBa2Cu3O7-BaHfO3 superconducting nanocomposite films

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After 25 years of development, several high-temperature superconductors (HTS) are becoming engineering materials commercially available as long-length wires. Among them, REBa2Cu3O6+y (REBCO, RE rare earth) compounds have emerged as excellent candidates for the manufacture of superconducting Coated Conductors (CCs) due to their high-field current carrying capacity. REBCO nanocomposites, based on the introduction of nanometric non-superconducting secondary phases in the superconducting matrix, have appeared as interesting materials to improve the superconducting properties and pinning performances in a wider range of applied magnetic fields and temperatures.
Chemical solution deposition (CSD) has been demonstrated to be a scalable, versatile and cost-effective technique for in-situ preparation of REBCO thin films with embedded oxide secondary phases, starting from a complex metalorganic precursor solution. In such films, the nanoparticles tend to randomly orient in the REBCO matrix creating a high density of secondary defects which generate a nanostrained REBCO matrix that ultimately lead to a strong enhancement of the isotropic pinning contribution.
In this work, we present the superconducting properties of (Y/Gd)BCO+12 mol% BaHfO3 nanocomposite films deposited on single crystals (SrTiO3) and on buffered tapes. After a complex growth-parameter optimization for different Y/Gd ratios, we have been able to obtain high-quality films on both kinds of substrates. Large critical current densities (Jc = 7 MA/cm2) and pinning forces (Fp = 16 GN/m3) are achieved e.g. for a 220 nm GdBCO+12%mol BaHfO3 film on SrTiO3, values among the highest in literature. Also, 1 micron thick films were prepared showing an excellent texture and large values of critical current (Ic). Finally, the results we obtain working with the buffered tapes demonstrate that our approach is very promising for future industrial application since we were able to grow films that present similar features than the ones obtained in single crystals.

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