Effect of processing parameters on the morphology, particulate, and superconducting properties of electrospun YBCO nanostructures

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ABSTRACT

Superconductivity in nanostructured ceramics offers significant advantages over the conventional coarse-grained materials in view of miniaturization of superconducting electronic devices. In this paper, we report the formation of four morphologies of superconducting $YBa_2Cu_3O_{7-\delta}$ (YBCO) nanostructures by electrospinning technique using polymeric polyvinyl pyrrolidone (PVP) solutions of different molecular weight and altering the total content of the metallic precursors. The morphologies prepared using this strategy are nanorods (NRs), nanogarlands (NGs), nanohierarchical (NH), and nanoparticles (NPs). Alternating current susceptibility measurements showed high critical temperatures (T_C ~90 K) for the NH YBCO synthesized using PVP of the lowest molecular weight; whereas the YBCO NRs synthesized using a higher molecular weight polymer showed the lowest T_C (82 K). A relationship between the particulate properties and T_C was also observed – the lower is the pore size the higher is the T_C. The YBCO NGs showed the highest specific surface area (7.06 m^2/g) with intermediate T_C (88 K). Electrospinning process appears an effective and controllable technique to produce different nanomorphologies with intrinsic properties suitable for practical applications.

KEYWORDS

High-temperature superconductors; Nano superconductivity; Nanoscale superconductivity; Nanostructured materials; Particulate properties; Transition temperature

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