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M2Or4B-02: Systematic Studies to Enhance Flux Pinning of (BaZrO3/YBa2Cu3O7-x)N Multilayer Thin Films for the Full Landscape of T = 5K to 77K

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The addition of nanosize defects to (Y,RE)Ba2Cu3O7-z (Y,RE-Ba-Cu-O or (Y,RE)BCO) superconductor thin films have been studied by many groups world-wide, to enhance flux pinning and strongly increase critical current densities (Jcs). A large variety of defect additions have been studied, including so-called 1D, 2D and 3D defects. The (M/(Y,RE)BCO)N multilayer system has been studied by many groups, and achieves interesting variations of Jc(H,T,Θ) in the operation space of T = 5-80K, Happl = 0-9T and 0° ≤ Happl(Θ) ≤ 90°. Herein provides a wide-ranging optimization study of (BaZrO3, y/YBa2Cu3O7-x ,z)N multilayer films prepared by pulsed laser deposition with y,z layer thickness and N # of layers. Process parameters studied include YBa2Cu3O7-x (YBCO) layer thickness from 3-300 nm, BaZrO3 (BZO) layer thickness from 0.5-1.5 nm, and film growth temperature from 775-825 ℃. Systematic results of critical transition temperature (Tc) and Jc(H,T,Θ) were plotted as function of YBCO layer thickness and BZO addition up to 16 volume %. Optimization of Jc(H,T,Θ) was found to vary with process parameters from 30-77 K, for example at 77 K flux pinning was optimized and only clearly exceeding pinning YBCO-alone films for 825 ℃ process temperature. However, for 30 K operation temperature, flux pinning was much less sensitive to BZO+YBCO film parameters, and slightly optimized for 805 ℃ process temperature. For all H,T conditions studied, the Jc(H,T) values achieved a maximum peak for BZO = 8-12 volume % additions in close agreement with published models of flux pinning, and required BZO layer thickness < 0.6 nm.

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