Growth and superconducting properties of YBCO films on conductive Nb-doped $SrTiO_3$ and Ni buffered {100}<001> Cu tapes

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High critical current density (J_c) $YBa_2Cu_3O_7$ (YBCO) superconducting films have been grown on cube-textured metal tapes for the purpose of developing second generation (2G) superconducting wires for high temperature, high magnetic field applications. In the standard RABiTS approach, a biaxially crystal aligned YBCO layer is deposited on a Y_2O_3/YSZ/CeO_2 buffered Ni-W alloy tape.

2G superconducting wires become highly resistive when they are quenched, therefore, to manufacture reliable and safe HTS applications, it is necessary to use conducting (metal) layers with low resistivity such as Cu and Ag to attach to the 2G superconducting wires to stabilize and protect the wires from damage due to quenches. Presently, insulative oxides are used for the buffer layers, thus thick Ag and Cu layers are required to be deposited as the stabilizer layers on the YBCO layer. However, the high material and process costs for the Ag and Cu layers are one of the major obstacles for achieving low-cost 2G superconducting wires. Because the resistivity of pure Cu is much lower than that of the Ni-W alloy, use of a conductive buffer layer instead of the insulative ones combining with textured Cu tape, can release 2G superconducting wires from the expensive Ag and Cu stabilizer layers.

We prepared Nb-doped $SrTiO_3$ films on a Ni-electroplated {100}<001> textured Cu tape laminated with SUS316 and epitaxially grew YBCO layers on them. J_c of the YBCO layer on the Nb-STO/Ni/Cu/SUS316 was 1.2 MA/cm^2 at 77 K in self field. When changing to normal conductivity, new structure has gradual voltage slope compared with conventional structure. We confirmed that the textured Cu tape worked as not only the template but also the stabilizing layer by applying conductive Nb-doped $SrTiO_3$ as a buffer layer. We believe that our new architecture will play an important role for realizing a low-cost 2G superconducting wire.

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