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Study on $(Nd_xSr_{1-x})TiO_3$ thin film as conductive buffer layer for low-cost REBCO wire

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To develop low-cost REBCO superconducting wires, we have developed a new architecture using conductive rather than insulating buffer layers, combined with {100}<001> textured pure Cu tape to form $YBa_2Cu_3O_7$/Nb-doped $SrTiO_3$/Ni/Cu/stainless steel tape. In this structure, the textured pure Cu tape is expected to work not only as the template for YBCO biaxial crystal alignment but also as the stabilizing layer. We fabricated YBCO/$Sr(Nb_{0.15}Ti_{0.85})O_3$/Ni/Cu/SUS316 short sample with the J_c of 2.5 MA/cm^2 (at 77 K, self-field), and also confirmed that some current flowed into the Cu tape through the conductive buffer layers when the current exceeded the critical current of the YBCO layer [1]. However, although the resistivity of $Sr(Nb_{0.15}Ti_{0.85})O_3$ was assumed to be approximately (1.2–8.6) × 10^{-3} ohm-cm at 77 K before the YBCO deposition, the resistivity of $Sr(Nb_{0.15}Ti_{0.85})O_3$ layer in the YBCO/$Sr(Nb_{0.15}Ti_{0.85})O_3$/Ni/Cu/SUS316 increased to be few ohm-cm after the YBCO deposition and/or oxygen annealing. Because lower resistivity of the conductive buffer layer is favorable, we tried to suppress the increment of the resistivity during the YBCO deposition and oxygen annealing. In this study, we applied $(Nd_xSr_{1-x})TiO_3$ to the conductive buffer layer instead of $Sr(Nb_{0.15}Ti_{0.85})O_3$.
The electrical resistivity of the as-grown $(Nd_{0.1}Sr_{0.9})TiO_3$ thin film prepared on $LaAlO_3$ single crystal substrate by a PLD method was 4.55×10^{-2} ohm-cm at 77 K. $(Nd_xSr_{1-x})TiO_3$ and YBCO layers were prepared by a PLD method on the Ni-electroplated Cu/SUS316 tape. Fig.1 (a) and (b) show X-ray {110} pole figure and SEM image of the $(Nd_{0.1}Sr_{0.9})TiO_3$ thin film prepared on the Ni/Cu/SUS316. We can see that the $(Nd_{0.1}Sr_{0.9})TiO_3$ film had excellent biaxially crystal orientation and smooth surface. Fig. 1 (c) shows X-ray (102) pole figure of the YBCO prepared on the $(Nd_{0.1}Sr_{0.9})TiO_3$/Ni/Cu/SUS316. We confirmed that the YBCO also had excellent biaxially crystal alignment.
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[1] Doi et al., appl. Phys. Express 12 (2019) 023010.

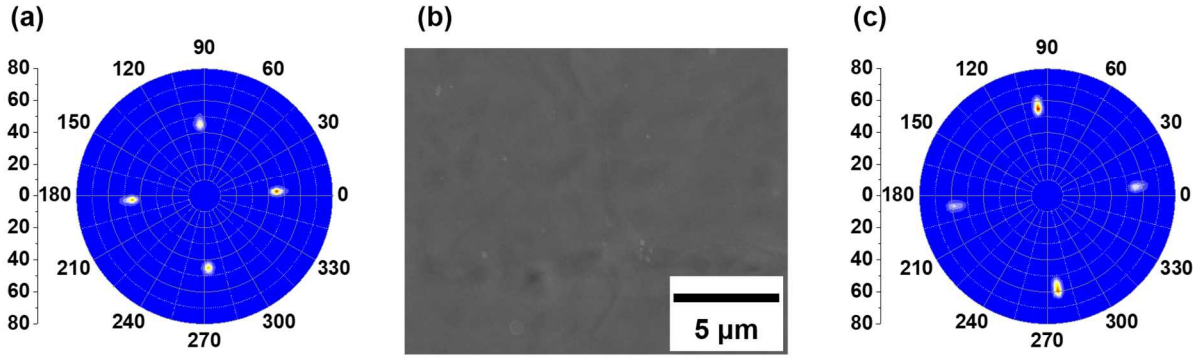

Fig.1(a) X-ray {110} pole figure and (b) SEM image of the $(Nd_{0.1}Sr_{0.9})TiO_3$ prepared on the Ni/Cu/SUS, and (c) X-ray (102) pole figure of the YBCO prepared on the $(Nd_{0.1}Sr_{0.9})TiO_3$/Ni/Cu/SUS.

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