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Nb-rod-method Cu-Nb/Nb₃Sn wires for practical React-and-Wind applications

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Nb-rod-method Cu-Nb reinforced bronze process Nb₃Sn (Cu-Nb/Nb₃Sn) wires are applicable to React-and-Wind processed Nb₃Sn coils. The Cu-Nb composite material functions as a reinforcing stabilizer during the superconducting magnet operation. Moreover, it suppresses the damage of reacted Nb₃Sn filaments due to the applied stress during manufacturing process such as the pre-bending treatment, the insulating and the winding. Plural new Cu-Nb/Nb₃Sn wires with the high tin bronze (Cu-15.7wt%Sn-0.3wt%Ti) were investigated in the superconducting properties. The round wire of 0.8 mm diameter with pre-bending strain of $\pm 0.5\%$ demonstrated the non-Cu-J_c values (at 4.14 K, defined by 10 micro-V/m) of 1150 A/mm² at 12 T and 410 A/mm² at 17 T, which were 1.5 times and 1.4 times larger than those of the previous wires (with Cu-14wt%Sn-0.2wt%Ti). As for rectangular wires of 1.7 mm x 1.13 mm, the pre-bending strain was applied from the flatwise direction and/or the edgewise direction. In case of pre-bending strain of $\pm 0.5\%$ applying alternately from both directions, the non-Cu-J_c was 355 A/mm² at 17 T of which was 1.6 times larger than that of the as-reacted wire without pre-bending treatments. These results suggest that the performance of large capacity conductors consist of the advanced Cu-Nb/Nb₃Sn wires can be further improved by controlling both magnitude and direction of the pre-bending strain in React-and-Wind process.

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