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Unique and Novel High Tin Bronze and Nb3Sn Multifilamentary Wires

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In the industry for Nb3Sn conductors at the moment, it is considered that 16 mass% is a limit of the tin content for the bronze process as well as a limit of the critical current density (Jc). Because the mechanical performance of the bronze dramatically changes from ductile to brittle with increasing the thin concentration over 16 mass%. Therefore, the internal tin process using pure tin rod is adopted at predominant companies in the world for producing Nb3Sn wires having large Jc. However, some problems on the internal tin process, such as a tin leakage, low RRR, SC filament merging, large effective filament size, formation of large voids, less mechanical strength, dielectric breakdown, and etc., are of concern.
This brittleness of the high tin bronze over 16 mass%Sn is originated from the precipitation of the coarse delta phase. In conjunction with titanium additives, the coarse delta phase disappeared perfectly and replaced amazingly finer Cu-Sn-Ti ternary precipitates. Eventually we have developed the special bronze with 17.5-18.5 mass%Sn. These super-high tin bronze showed a good ductility at room temperature, and it was successfully fabricated 1,615 multifilamentary wires. In addition, we also studied a simultaneous addition of Ti and Hf to the super-high tin bronze alloys, and tried to fabricate multifilamentary wires as well. In this paper, we will report superconducting properties and microstructures of those unique and novel bronze alloys and Nb3Sn multifilamentary wires.

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