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Wed-Af-Po3.21-06 [72]: Fundamental study on the effect of Zn addition into Cu matrix in internal tin Nb3Sn conductors

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As a new approach to enhance the Jc property, we have been studying the element addition into the Cu matrix in the internal tin Nb3Sn conductors. We have shown so far that Zn addition promotes the Nb3Sn layer formation, compared to the non-doped Cu matrix Nb3Sn wires.
In this work, we concentrated to investigate the effect of Zn addition on the microstructure during the heat treatment in detail thorough fundamental study. First, various single Cu-Zn/Sn composites were prepared and then their reaction behaviors were observed with respect to the heat treatment condition. The most interesting finding was that the Cu-Zn/Sn diffusion couples resulted in a significantly different reaction behavior from the Cu/Sn diffusion couple. For example, in the Cu/Sn couple, ε phase widely forms together with η phase at the reaction layer at 400 ⊠C, while in the Cu-Zn/Sn couple, another ternary Cu-Sn-Zn phase (presumably β-CuZn) forms adjacent to ε phase. This was considerably interesting, because this ternary phase is quite solid and no void is present, while the ε phase contains many voids. The suppression of void formation should be important for the improvement of Cu/Sn interdiffusion during the pre-annealing in the multifilamentary precursor wires. In our laboratory scale Nb3Sn multifilamentary wire samples, the Jc in the Cu-Zn matrix samples is appreciably better than that in the Cu matrix sample, which would be attributed to the improvement of Sn diffusivity in the pre-annealing process. In addition, we investigated optimum Zn content in the Cu matrix, the grain size and the influence of the filament barrier thickness and so on.
The Zn addition into the Cu matrix is fairly interesting for further Jc improvement of the Nb3Sn conductors in terms of uniform Sn diffusion across the matrix and acceleration of the Nb3Sn layer formation.
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