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Novel Pb- and Cd-free superconducting joint between NbTi and Nb3Sn wires using high-temperature-tolerable superconducting Nb-alloy intermedia

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Pb–Bi alloy and Wood's metal have been used for more than 30 years as representative superconducting solder intermedia to establish superconducting joints between NbTi and Nb3Sn wires. However, the use of Pb and Cd has been severely restricted by environmental regulations. The author has developed a novel alternative superconducting joint method between NbTi and Nb3Sn wires without Pb and Cd. The key point is to use a high-temperature-tolerable (HTT) Nb-alloy as an intermedia, whose critical current does not deteriorate even after exposure to temperatures higher than 650 ℃. That enables us to establish a superconducting joint between Nb3Sn filaments and one end of the HTT Nb-alloy core via a chemical reaction, where a perfectly superconducting Nb3Sn layer is formed at the interface. Then, the other end of the HTT Nb-alloy core was cold-pressed with NbTi filaments to connect their active new surfaces to each other to create a superconducting joint. Ultimately, a superconducting joint between NbTi and Nb3Sn wires was realized. Hf-added Nb-alloys are promising candidates for the HTT Nb-alloy. The ultra-low resistance of the joint was confirmed by a current decay measurement.This method of forming a superconducting joint is promising for application in environmentally friendly nuclear magnetic resonance magnet systems.

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