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M1Or2A-02: Flux pinning mechanism in Nb3Sn conductors with artificial pinning centers

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Nb3Sn is a low-temperature superconductor that had been believed to have very limited room for further improvement. However, the development of Nb3Sn wires with artificial pinning centers (APC) in recent years shows that Nb3Sn conductors can still be significantly improved. The most recent APC wires, in which Nb-Zr is internally oxidized to form ZrO2 particles, have achieved non-Cu Jc values significantly above the two-decade-old record, especially at high fields (20-25 T). In this talk the properties of the APC Nb3Sn conductors are shown, and then the flux pinning mechanism for them is discussed. In contrast to conventional Nb3Sn conductors whose Fp-B curves peak at 0.2Bc2, those of the APC conductors shift towards 1/3Bc2. The improved pinning in the APC wires has long been believed to be caused by their refined Nb3Sn grain size because grain boundaries are the primary fluxon pinning centers for conventional Nb3Sn. Recent experimental studies, however, show that the ZrO2 particles, which serve as point pinning centers, may play a more important role than the refined grain size. The size and distribution of ZrO2 particles are studied with transmission electron microscope (TEM). These studies point to the direction for further improvement of Nb3Sn conductors.

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