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M1Or3A-05 [Invited]: Nb3Sn conductors with artificial pinning centers

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The recent progresses, properties, and future work of APC Nb3Sn conductors are reported. Great progresses have been made in the past two years in developing the APC Nb3Sn wires, including adding Ta dopant and improving wire recipe and quality. This has led to great improvement in their properties. The most recent APC wires have achieved Bc2 (4.2 K) above 28 T (1-2 T higher than conventional best Nb3Sn wires) and non-Cu Jc values above the Jc specification required by the Future Circular Collider (FCC). Other unique features of the APC wires that are not seen in conventional Nb3Sn conductors, such as much higher Sn content in Nb3Sn layers and shift of Fp-B curve peaks to higher fields, are discussed in details. The causes for the high Sn content are explained by a diffusion reaction theory developed for the growth of Nb3Sn layer. The shift in Fp-B curve peaks and improvement in pinning force have long been believed to be caused by the refined Nb3Sn grain size in the APC wires. Here experimental studies show that the ZrO2 particles, which serve as point pinning centers, play a more important role than the refined grain size. The size and distribution of ZrO2 particles are observed with transmission electron microscope (TEM). At last the future work needed for the development of APC wires is reported, including optimization work to further push the performance and work that is still needed to make practical long-length magnet-grade conductors.

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