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M3Or3J-01: [Invited] Dual Flux Pinning Mechanisms and the Effect of Microstructure on Pinning and Critical Current in APC Nb3Sn

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APC Nb₃Sn wires have been made which incorporate non-superconducting nanometer-scale inclusions in the form of ZrO₂ or HfO₂. In addition to strengthening the surface-type flux pinning by refining the grain size, the nanoparticles introduce a point-type pinning mechanism, the efficacy of which peaks at higher magnetic field than the grain boundary pinning. However, the size and spacing of the point pins is not uniform. While a particle is most effective at pinning when its radius is the same as the superconducting coherence length (˜3.5 nm in Nb₃Sn), the particles have a distribution of sizes which can be affected by heat treatment and strand composition. We evaluate the effect of changes to the size of the nanoparticles due to the choice of alloying element and heat treatment on the flux pinning. In addition, the interplay of coexistent surface and point pinning and the behavior as pin density approaches the fluxon spacing are considered.

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