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The development of high pinning site densities in multifilamentary PIT wires using the internal oxidation route

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Prior to his passing in late 2016, Leszek Motowidlo developed a method of applying the Nb-1Zr/SnO₂ internal oxidation method to APC Nb₃Sn through a powder-in-tube (PIT) approach that used low-cost Cu₅Sn₄ powder as the Sn source. Two designs of multifilamentary PIT wire were successfully produced and fine-grain A15 layers with average grain diameters as small as 30nm were obtained. High resolution field emission SEM also indicated the presence of point pinning sites, particularly at grain boundaries. Magnetization and transport critical current tests showed a shift in the peak of the pinning force curve toward higher magnetic field. Deconvolution of the pinning force curves indicated a strong point pinning component, perhaps produced by the ZrO₂ precipitates. It was found that the degree of microstructural refinement was very sensitive to the volume percent of SnO₂ in the core. This presentation will also look at some limitations of this technique, which included a strong gradient in grain size, uneven distributions of point-pinning sites and relatively low levels of conversion of Nb₆Sn₅ to Nb₃Sn. Such compromises will need to be addressed to make this approach competitive with more fully developed conventional internal Sn and PIT Nb₃Sn wires.

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