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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 30nbsp;nm 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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