**Hysteretic Losses in Twisted Bi-2212 Round Wires**

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**Introduction**

 Minimizing hysteretic losses of Bi-2212 round wires is important for high field magnet applications. We have shown that hysteretic losses in Bi-2212 can be reduced to acceptable levels (<500 mJ cm-3) by twisting, without lowering its transport critical current density Jc. At their lowest, hysteretic losses per wire volume in standard, 0.8 mm diameter, 37x18 overpressure processed Bi-2212 wires are comparable to ITER reference Nb3Sn strands. Comparison of different filament configurations, namely the densely packed 37x18 and the sparsely packed 27x7 reveals that twisting is not as effective in reducing losses in the more densely packed wire. This is known to be due to physical bridging of the filaments, some of which enhance losses by providing highly connected paths for interfilament coupling.

**Experimental**

 We measured the dependence of losses on sample length for 0.8 mm diameter Bi-2212 round wires with both densely (37x18) and sparsely (27x7) packed filaments. We progressively cut turns from these ~95 mm long coils (ID 5 mm) and measured the magnetization loops (4.2K, ±3T) in a VSM after each cut. Hysteretic losses were calculated by integrating these loops. We calculated the effective filament diameter values using the critical state model based on the original round wire diameter of the filament before reaction, although it is clear that large geometrical uncertainties exist about real filament shapes after reaction.

**Results and Discussion**

 The results in **Fig. 1** show that twisted wires have a magnetization that saturates at about the twist pitch of 64 mm while the untwisted wires magnetization continues to increase with length, showing that large currents flow across the Ag between filaments (and perhaps some Bi-2212 connections). The difference between the large separation 7 x 27 and more usual dense-packed separation of the 37 x 18 filament arrays is that Bi-2212 connections are common in the normal 37 x 18 stack and rare in the 7 x 27 stack. The terminal twisted magnetization of the dense filament array is about 3 times that of the sparse filament array, even though both have the same nominal filament diameter before reaction. This implies two additional factors, one that some of the Bi-2212 connections do carry supercurrent [1] and second that the complex rather chaotic microstructure of each filament which is anisotropic at the local level, even though the wire as a whole is isotopic) cannot be effectively modelled by an isotropic cylindrical approximation.

**Fig.1** Effective filament diameter versus sample length.

 Though these losses are larger than expected under the isotropic approximation, they are small compared to any other HTS conductor and very similar to ITER Nb3Sn conductors.

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**References**

[1] Sumption, M.D., *et al*., Physica C: Superconductivity, **291**, 267-273 (1997).