INTRODUCTION

Bi$_2$Sr$_2$CaCu$_2$O$_x$ (Bi-2212) conductor is the only high temperature superconductor manufactured in the round wire form, which enables twisting and Rutherford cables. It is very promising for very high field applications that can reach fields beyond those achievable using Nb$_3$Sn technology, such as general purpose research magnets, NMR magnets, and accelerator magnets. Bi-2212 round wire is fabricated as a multi-filamentary conductor by the powder-in-tube (PIT) method, but it must be heat treated at final size by partial melting to develop a high current density.

Bi-2212 wires are available in multiple architectures and kilometer pieces for high field coil fabrication. One of the key design parameters for manufacturing Bi-2212 wire is the filament size, which is believed to affect the current density and the filament coupling. As we are making a variety of 2212 coils, we wanted to understand the potential drawbacks to using these architectures at sizes different from their nominal optimized filament diameter.

PROCEDURE

We started with a wire (pmm151103) with 121x18 filaments. This wire was drawn into three different diameters (1.0 mm, 1.3 mm, and 1.5 mm.).

We ground and polished the transverse cross sections of the green (as-drawn) wires, and counted the number of merged filaments in the green wire.

We quenched the wires from the melt at 874 °C, which is the temperature at which Bi-2212 crystals start to form during the slow cooling stage of the standard heat treatment with 1 bar flowing oxygen.

We changed the time-in-the-melt by changing the rate of the slow cooling, 2.5 °C/hour (standard), 1 °C/hour (slower), and 4 °C/hour (faster).

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