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Behavior of Bi-2212 wires above liquid Helium temperature: critical current, irreversibility field and filaments coupling

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In recent years, there has been a renewed interest in the suitability and use of the Bi-2212 wires in various fields of application. Many studies highlight the possibility to use Bi-2212 for high magnetic field magnets above 18-20 T.
The purpose of this work is to study the electrical properties of Bi-2212 wires at temperatures above liquid Helium. The samples were obtained via a novel process developed at CNR-SPIN based on an alternation of drawing and groove rolling (GDG). Two samples made by employing Nexans and the new Engi-Mat Bi-2212 precursor powders were investigated. A first characterization was performed with the aim to evaluate the irreversibility field as a function of the temperature (Birr(T)). The Birr(T) dependence was extracted from the bulk pinning force density obtained from the magnetic hysteresis loop M-H measurements performed at different temperatures with the magnetic field directed perpendicular to the sample longitudinal axis. These studies show the suitability of Bi-2212 wires for high magnetic field applications, with good stability of critical current, a non-abrupt decrease in the magnetic field in the range 8 - 12 K, and, most interestingly, an irreversibility field higher than 70 T at 10 K.
Second, by comparing the critical current densities obtained by electric transport and magnetic M-H measurements, by applying the Bean critical state model, we were able to describe the behavior of the filaments-connection bridges, typical in Bi-2212 wires. Moreover, we were able to determine the temperature and magnetic field conditions in which filaments within a bundle are electrically coupled, as well as the opposite limit in which single filaments behave as individuals carrying current elements. We believe that the reported results can be considered of general validity and useful in magnet design.

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