Supercond. Sci. Technol. **25** (2012) 125002 (7pp) doi:10.1088/0953-2048/25/12/125002

Insight into non-linearly shaped superconducting whiskers via a synchrotron nanoprobe

Stefano Cagliero[1], Elisa Borfecchia[1], Lorenzo Mino[1], Leandro Calore[1], Federica Bertolotti[1], Gema Martinez-Criado[2], Lorenza Operti[1], Angelo Agostino[1], Marco Truccato[3], Petre Badica[4] and Carlo Lamberti[1]

[1] Department of Chemistry, NIS Centre of Excellence, INSTM Unit, University of Turin, Via P Giuria 7, I-10125, Turin, Italy
[2] European Synchrotron Radiation Facility, 6 rue Jules Horowitz, BP220, F-38043, Grenoble CEDEX, France
[3] Department of Physics, NIS Centre of Excellence, CNISM UdR, University of Turin, Via P Giuria 1, I-10125, Turin, Italy
[4] National Institute of Materials Physics, Atomistilor 105bis, 077125, Magurele, Romania

E-mail: marco.truccato@unito.it

Received 29 July 2012, in final form 20 September 2012
Published 15 October 2012
Online at stacks.iop.org/SUST/25/125002

Abstract
We were successful in synthesizing non-linear YBa_2Cu_3Ox whiskers, i.e. half loops or kinked shapes, which are promising candidates for solid-state devices based on the intrinsic Josephson effect and with improved electrical connections. We report on a complete characterization of their structural properties via a synchrotron nanoprobe as well as laboratory single-crystal diffraction techniques. This investigation allowed us to fully disclose the growth mechanism, which leads to the formation of curved whiskers. The superconducting properties are evaluated in comparison with their straight counterpart, revealing a strong functional analogy and confirming their potential applicability in superconducting electronic devices.

(Some figures may appear in colour only in the online journal)

1. Introduction

Since the discovery of high-T_c cuprate superconductors, much attention has been dedicated to the growth of single crystals for fundamental research and electronic applications. In this framework, in the past few years, $Bi_2Sr_2CaCu_2O_{7+x}$ (Bi-2212) and $YBa_2Cu_3O_x$ (Y-123) whisker-like crystals have attracted significant attention because of their very good crystallinity, peculiar dimensions with micrometric cross sections, leading to high aspect ratios, and outstanding superconducting properties.

The successful growth of Y-123 whiskers has been reported more recently than the well-known Bi-2212 family, but a good level of characterization of their superconducting properties has already been achieved [1, 2].

A series of recent publications shows that high-T_c whiskers, exploiting the intrinsic Josephson effect and related phenomena, can be successfully employed in the fabrication of micro/nano-devices, such as: THz emitters/sensors, micro-SQUIDs' and quantum bit-computing based on macroscopic quantum tunneling phenomena [3–7]. From the applications point of view, the possibility of obtaining superconducting crystals with curved shapes, maintaining the same superconducting properties as the straight ones, would open the way to the realization of novel and interesting solid-state devices. For instance, solid-state micro-coils with high critical currents could be applied in the generation of extreme magnetic forces, while the exploitation of the intrinsic Josephson effect could take advantage of the introduction of diverse crystal geometries, such as half loops or kinked shapes. Moreover, the availability of curved whiskers would allow the fabrication of systems with improved electrical connections [8, 9].

