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Bi-2212 and Y123 highly curved single-crystal-like objects: whiskers, bows and ring-like structures

Petre Badica[1,2], Angelo Agostino[3], Mohammad Mizanur Rahman Khan[3,4], Stefano Cagliero[3], Carmen Plapcianu[1,5], Linda Pastero[6], Marco Truccato[5], Yuichiro Hayasaka[7] and Gerhard Jakob[2]

[1] National Institute of Materials Physics, Atomistilor 105bis, 077125 Magurele, Romania
[2] Institute of Physics, Mainz University, Staudingerweg 7, D-55127 Mainz, Germany
[3] NIS Center of Excellence, Department of Chemistry, University of Torino, Via P. Giuria 7, I-10125, Torino, Italy
[4] Department of Chemistry, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh
[5] CNISM and NIS Center of Excellence, Department of Physics, University of Torino, Via P. Giuria 1, I-10125 Torino, Italy
[6] Department of Earth Sciences, University of Torino, Via Valperga Caluso 35, I-10125 Torino, Italy
[7] High Voltage Electron Microscopy Laboratory, IMR, Tohoku University, Katahira 2-1-1, Aoba, Sendai, 980-8577, Japan

E-mail: badica2003@yahoo.com

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Abstract
High-temperature superconducting objects of $Bi_2Sr_2CaCu_2O_8$ and $YBa_2Cu_3O_7$ highly curved in the *ab*-plane, such as curved/kinked whiskers, bows and ring-like structures, were obtained within a solid–liquid–solid (SLS) grass-like growth mechanism. As-grown objects are crystals with three-dimensional epitaxy similar to conventional single crystals: they can be viewed as crystal parts 'cut' from a conventional rectangular crystal. Between our curved objects and conventional crystals, whiskers or thin films there are some differences in the superconducting properties induced only by the shape factors and no new physics is observed. Some details of the growth mechanism are discussed, emphasizing curved-line formation.

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

1. Introduction

Shape control is one essential ingredient for the generation of materials with new functionalities. Shape formation usually takes place from simple to complex through a process of organized 'assembly' (or 'self-assembly') [1, 2] or by controlled 'processing' (or 'self-processing'), e.g. by bending, twisting, rolling [3, 4]. 'Assembly' and 'processing' can sometimes overlap, but typically they are governed by different forces between the building elements and the environment. Knowledge of the corresponding forces and mechanisms represents an essential preliminary requirement for controlling shape formation in both cases. Concerning the 'assembly', there are two important observations, and their implications.

Firstly the smallest building elements are usually in the nanosize range, but the resulting objects can be at nano, micro- or larger scale. The relevant forces for assembly and shape formation can be different at different scales (e.g. due to surface to volume ratio changes). However, there are cases when it can be considered that assembly proceeds with the same driving force, from the nano-scale all the way up to the micro-scale or higher range. One such example is growth in a mainly layer-by-layer physical condensation

