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### Prototyping new type $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$ devices using a consumer-oriented inkjet printer

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We are attempting to prepare planar type intrinsic Josephson oscillator devices. These new type devices can be prepared by a combination of orientation control technique of  $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$  (Bi2212) thin film by solution method and printing method using inkjet printer. In order to prepare these planar type devices, it is necessary to form a current path parallel to the substrate, so that the  $c$ -axis of Bi2212 is required to be parallel to the substrate.

We have prepared (010) (or (100)) oriented Bi2212 thin films by metal-organic decomposition (MOD) method which is one kind of solution method [1]. When using vicinal (100) substrates, the Bi2212 (020) (or (200)) peak appeared clearly in the X-ray diffraction patterns. From the scanning electron microscope (SEM) image, it was found that elongated plate-like crystal grains of Bi2212 were grown. From the viewpoint of lattice matching, this elongated crystal grain is considered to be (010) (or (100)) oriented Bi2212 crystal grains.

Since we have succeeded in forming crystal grains that the  $c$ -axis is parallel to the substrate, we are now attempting on prototyping device using a consumer-oriented inkjet printer. The main component of the solvent in the Bi2212 raw material solution is xylene. Some inkjet printer components have low resistance to xylene, such as the packing of the printer head. Therefore, the Bi2212 raw material solution cannot be used by filling in the ink cartridge. In this report, microfabrication is performed by lithography and chemical etching. The printing method using an inkjet printer is applied to the lithography process. The device fabrication procedure is as follows.

(1) Using a spin coater, the raw material solution is applied to the entire surface of the substrate.

(2) The substrate coated with the solution is heat-treated using an electric furnace.

(3) Photoresist is applied to the sample in a desired pattern using an inkjet printer.

(4) Etching with acid is performed.

(5) The photoresist is removed.

We are using an EPSON inkjet printer capable of CD label printing. The samples will be evaluated based on SEM images and electrical characteristics. Details will be discussed in the presentation.

[1] Yamada Y et al., Journal of Physics: Conference Series (to be published)

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