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Monitoring of thin layer deposits of high temperature superconducting materials by energy-dispersive X-ray fluorescence technique (EDXRF)

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Abstract. We present here a method for rapidly monitoring the composition of samples deposited on a substrate. This was applied to the case of superconducting material $YBa_2Cu_3O_7$ deposited by laser evaporation on quartz plates. The aim of this study was to achieve the right composition of the deposited material so as to have it superconducting at high temperatures. The monitoring was done by comparing the X-ray spectrum obtained by EDXRF technique of the deposited film with the spectrum of the original superconducting material. By this method of signature analysis it was possible to arrive at the laser beam parameters which give the elemental composition of the deposited material almost as same as that of the original material. The optimization was done by changing the laser power and pulse width and monitoring the X-ray fluorescence spectra as a function of the beam parameters.

Keywords. High temperature superconductivity; $YBa_2Cu_3O_7$; thin film laser deposition; energy-dispersive X-ray fluorescence analysis.

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A number of techniques such as X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), secondary ion mass spectrometry (SIMS) etc have been employed to characterize the surface properties of deposited materials. Recently to determine the composition of deposited film obtained from high T_c superconducting material, the Rutherford backscattering (Dijkkamp *et al* 1987) and XPS (Jin *et al* 1987) have been employed. In order to determine rapidly the elemental composition or thickness of one or more elements deposited on any substrate, EDXRF has been widely applied (Huang and Parrish 1979; Laguitton 1977; Stine and Leidl 1974; Gianelos 1974; Lal and Choudhury 1987) due to the advantage of its high sensitivity and ease of analysis. This method has an added advantage of being non-destructive which is an essential requirement for many applications.

Recently there have been significant developments in the area of high temperature superconducting materials and one of the compounds showing superconducting behaviour at high temperatures is $YBa_2Cu_3O_7$. For many applications such as junction devices, accelerator cavities, etc., the material used is required to be in the form of a thin film, with superconducting properties. Various methods such as multi-target evaporation (Laibowitz *et al* 1987), sputtering (Kawasaki *et al* 1987), plasma spraying (Elam *et al* 1987) and laser beam (Dijkkamp *et al* 1987) are being tried for obtaining thin film deposits of required composition.

We report here the results of thin films prepared by laser evaporation. The film was prepared on quartz plates placed in $\sim 10^{-4}$ torr oxygen using a Nd-Yag laser beam (Chaddah *et al* 1987). The film thickness obtained was in the range of 1·0 micron.