Raman Spectroscopic Studies of $YBa_2Cu_3O_7$ Thick Films Grown by High-rate e-beam co-evaporation

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We present results of Raman spectroscopic studies of superconducting $YBa_2Cu_3O_7$ (YBCO) thick films grown by a high-rate electron-beam co-evaporation method. High-rate in-situ $YBa_2Cu_3O_{7-x}$ (YBCO) film growth was demonstrated by means of the electron beam co-evaporation. Even though our oxygen pressure is low, ~ 5 x 10^{-5} Torr, we can synthesize as-grown superconducting YBCO films at a deposition rate of ~10 nm/s. Relatively high temperatures of around 900 °C was necessary in this process so far, and it suggests that this temperature at a given oxygen activity allows a Ba-Cu-O liquid formation along with an YBCO epitaxy. Local critical current density shows a clear correlation with local resistivity. It is shown by x-ray diffraction that the as-grown YBCO films have a highly c-axis oriented and in-plane aligned texture. Polarized Raman scattering is used to characterize optical phonon modes, oxygen content and second phases of the YBCO coated conductors at ~100 μm scale. Raman spectra of YBCO coated conductors of less transport quality often show extra peaks at ~300 cm^{-1}, ~600 cm^{-1}, ~630 cm^{-1} although they all show various peak intensity of the apical oxygen mode at ~500 cm^{-1}, indicating presumably the different oxygen content. The information taken from the local measurement will be useful for optimizing process conditions.

keywords : Raman spectroscopy, YBCO thick films, e-beam evaporation

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