Pulsed Laser Deposition of YBa2Cu3Ox with Scanning Beam: Target to Substrate Composition Transfer and Film Structure

Pulsed laser deposition is often considered a process providing congruent transfer of target composition to the growing film. In fact, many different processes affect compositional preservation, starting from incongruent target ablation, to scattering on the way to the substrate, and to processes of the film formation on the substrate surface. We developed a pulsed laser deposition process trying to minimize the compositional deviations due to the scattering by the ambient gas by applying laser beam scanning across the target surface and substitution of oxygen with argon in the chamber during deposition. Transfer of elemental composition of YBa2Cu3O7 targets with compositions varying from stoichiometric 1/2/3 ratio was tested by deposition of thin films in conditions optimal for high-temperature superconductor formation. Despite all measures, the films still show Ba,Y enrichment due to different efficiencies of scattering on the ambient gas. The Y part in the film followed well the composition of the target, but the Ba enrichment was almost constant for most of the studied target compositions, implying a crucial role of the film growth processes. The YBa2Cu3Ox (YBCO) films show a layered structure, with increased density of defects in the topmost layer. We suppose this is due to expelling of the excess Ba into the top layer with formation of a quasi-liquid layer promoting formation of a high-density YBCO film.