Growth of c-axis Superconducting YBCO Films on Cu Substrate Using Cu-Free MOCVD Process

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Recently, researchers have worldwide focused on simplification of YBCO film processing (especially buffer layer processing) to make cost-effective YBCO coated conductors. However, fundamental process complexity which is now being faced due to introduction of buffer layer processing should be considered.

In this work, we developed a novel process to directly fabricate YBCO films on Cu substrate using Cu-free MOCVD process (eg. use of Cu substrate as a Cu source). We investigated deposition conditions, such as deposition temperature (from 820 to 880℃), deposition time (from 1 to 10 min), and cooling atmosphere (Ar, O_2, etc.) in terms of fabrication of MOCVD YBCO films on Cu substrate. At the early stage of YBCO growth on Cu substrate, YBCO grains were formed as islands surrounded with copper oxides (Cu_2O or CuO). After 5 min of deposition, YBCO grains were connected by island coalescence with grain size of a few ㎛. Cu oxidation behavior on film surfaces was controlled depending on cooling atmosphere (Ar versus O_2). At Ar atmosphere, only Cu_2O was formed on film surface and covered YBCO grains. On the other hand, O_2 atmosphere, CuO was also observed and located only at the grain boundary of YBCO. From X-ray Diffraction studies of the samples, we found that c-axis oriented YBCO grains were grown on Cu substrate. However, it was observed that interfacial oxides such as copper oxides were inevitably formed and much thicker (a few tens of ㎛) than YBCO films (below 1 ㎛). Critical transition temperatures of the YBCO films fabricated under various deposition conditions ranged from 49.3 to 64.2K. From the results, we found that it was possible to directly fabricate MOCVD YBCO films on Cu substrate without buffer layers using simplified Cu-free MOCVD process.

Keywords : YBCO, MOCVD, Cu substrate, Cu-free, copper oxides

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