Enhancement of critical temperature up to 30 K of (Ba1−xLa)xFe2As2 epitaxial films by high pressures

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High-pressure effects have been examined well on iron-based superconductors since the early stage of its research in order to enhance critical temperatures (Tc). The pressure effects on Tc were first investigated in 1111-type LaFeAs(O1−xFx) polycrystals [1]. The external pressure of 4 GPa enhanced Tc from 26 to 43 K. Since then, many types of iron-based superconductors such as 122-phase (AEFe2As2, AE = alkaline earth) and 11-phase (FeCh, Ch = chalcogen) were discovered, and the pressure effects on Tc have been investigated extensively for bulk samples [2]. In the case of 122-type BaFe2As2, the parent phase (not a superconductor) exhibits superconductivity with maximum Tc of 34 K by applying a pressure of ~1 GPa. A larger enhancement of Tc of 11-type FeSe from 8 K up to 37 K was observed. In contrast with cuprates, the sensitivity to external pressures is the distinctive character of the iron-based superconductors.

In this study, we examined pressure effects up to 3 GPa on the superconductivity of (Ba,La)Fe2As2 epitaxial films because we expected that applying external pressure would lead to a compression of the (Ba,La)Fe2As2 lattice and enhancement of the Tc.

We found that Tc shifted toward higher temperature upon applying hydrostatic pressure. The maximum Tc reached 30 K for the optimally doped sample. All the dTc/dP obtained for (Ba,La)Fe2As2 were positive. This result makes a distinct difference from those of Ba(Fe,Co)2As2, where dTc/dP is positive for the under-doped, zero for the optimally doped, and negative for the over-doped samples.