Transport properties of layered Ba(Pb,Bi)O$_3$ thin films

G.W.J. HASSINK, K. MUNAKATA, R.H. HAMMOND, M.R. BEASLEY, Geballe Laboratory for Advanced Materials, Stanford University, Stanford, CA 94305 — Doped BaBiO$_3$ is a 3D oxide superconductor with a maximum $T_c$ of 30 K for Ba$_{0.6}$K$_{0.4}$BiO$_3$. There has been a lot of discussion on whether this high $T_c$ can be explained purely by electron-phonon coupling with a high coupling constant $\lambda$. In addition, the presence of real-space paired $6s^2$ electrons in the parent compound raise intriguing questions about whether there is an electron-electron coupling interaction as well. This possible negative-U interaction might be used to implement the suggestion by Berg, Orgad and Kivelson [Phys.Rev.B 78, 094509] that for a two-layer system where one layer provides electron pairing interaction and the other layer is conducting, the whole can be superconducting with a high $T_c$. Here we discuss the transport properties of BaPbO$_3$/BaBiO$_3$ bilayers, where the BaBiO$_3$ layer is thought to act as the pairing layer, while the BaPbO$_3$ acts as the conducting layer. The transport behavior changes to insulating upon decreasing the metallic BaPbO$_3$ layer thickness at values that single films are expected to still be metallic.

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Date submitted: 17 Nov 2011          Electronic form version 1.4