Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Study of native oxide on MgB_2 thin films by electron tunneling[1]

KE CHEN[2], QI LI, X. X. XI[3], Department of Physics, Penn State University, University Park, Pennsylvania, USA — A native oxide of a few monolayers uniformly covering a metal film surface can often serve as a good tunnel barrier. Good quality MgB_2/native oxide/Pb Josephson tunnel junctions have been made despite little is known about the barrier's composition, which is studied by electron tunneling in this work. Native oxides were grown naturally on MgB_2 thin films in air at room or elevated temperatures up to 400 $^\circ$C right after the films were made by the hybrid chemical-physical vapor deposition method. I–V and dI/dV–V curves were measured on MgB_2/native oxide/Pb tunnel junctions, showing that the tunnel barrier has a typical thickness of about 1 nm and height of about 3 eV, more than 3 times higher than reports from other groups on the films made by other techniques. The phonon spectra of the native oxides were observed in voltages between $\pm$120 meV. The phonon structure is derived from the tunneling conductance curve and compared to that of MgO. Based on the barrier height, the phonon structure, and the photoemission spectra on the native oxide from Robert Buhrman's group at Cornell University, we conclude that the native oxide is mainly MgO doped with some boron.

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Date submitted: 14 Dec 2009 Electronic form version 1.4