Magnetic Field and Carbon-doping Dependent Far-infrared Studies of Epitaxial MgB$_2$ Films$^1$ JIUFENG TU, The City College of New York, G.L. CARR, QIANG LI, BNL, L. MYHALY, SUNY-Stony Brook, P. ORIGIANI, X.X. XI, Penn State — Magnetic field dependent (up to 10T) far-infrared transmission studies have been carried out for a series of pure and carbon-doped epitaxial MgB$_2$ films (between 30-40nm) on SiC substrates. While the carbon-doped film (30nm) exhibits the typical characteristics for a dirty BCS superconductor in the $T_S/T_N$ ratio, the pure MgB$_2$ films show anomalous behavior: the peak in the $T_S/T_N$ ratio is broad in frequency; and as the film thickness increases the peak height decreases. Both of these observations could be the direct results of multi-gap nature of the superconducting state in MgB$_2$. As a function of magnetic field, the pure MgB$_2$ films show saturation behavior beyond 8T which gives the value of $H_{c2}$ at 8T for these films. Interestingly, the carbon-doped film also exhibits saturation behavior at around 8T, suggesting that the carbon impurities are not effective pinning centers for the vortex flux. Reflectivity measurements are underway to deduce the absolute scattering rates for both pure and carbon-doped films in order to construct an effective BCS model with multiple gaps based on the infrared data.

$^1$Supported by CUNY-RF-80212-13-04, ONR-N00014-00-1-0294 and NSF-DMR-0306746.

Jiufeng Tu
The City College of New York

Date submitted: 01 Dec 2004

Electronic form version 1.4