Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Conductance Measurements of Magnesium Diboride-based Josephson Junctions Below 1 Kelvin: Beyond the 2-Gap Model[1] STEVEN CARABELLO, Drexel University, Penn State Harrisburg, JOSEPH LAMBERT, JEROME MLACK, Drexel University, WENQING DAI, QI LI, Penn State University, KE CHEN, DANIEL CUNNANE, Temple University, C.G. ZHUANG, None, X.X. XI, Temple University, ROBERTO RAMOS, Indiana Wesleyan University — Theoretical and experimental studies have probed the nature of magnesium diboride's two superconducting energy gaps Δ_π and Δ_σ. Several theoretical analyses have predicted fine structures within each energy gap, with recent experiments revealing similar structures. We have performed high-resolution tunneling measurements of low-transparency Josephson junctions using "terraced," "columnar," and c-axis MgB_2 films separated by its native oxide from either lead (Pb) or tin (Sn) counter-electrodes. Using high-resolution I-V data at T as low as 23mK, we observe sub-structures within both energy gaps. We also observe sharp peaks in the subgap that identify, to high precision, the energy gap values of the junction counter-electrodes (Pb and Sn). These lead us to conclude that the substructures seen in the gaps are due to MgB_2. We then fit the data using simplified two-gap and four-gap models with variable weights and broadening factors. By demonstrating the inadequacy of a simple two-gap model in fitting the data, we illustrate that some distinctions between theoretical models of energy gap substructures are experimentally observable.

[1]R.C.R. acknowledges partial support from National Science Foundation Grant # DMR-1206561.

Steven Carabello
Drexel University, Penn State Harrisburg

Date submitted: 15 Nov 2013 Electronic form version 1.4