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**Evolution of the Cooper Pair Insulator Phase in a-Bi Films  
Grown on Nanohoneycomb Substrates with Varying Surface Topography**

J.C. JOY, X. ZHANG, C. ZHAO<sup>1</sup>, S.M. HOLLEN<sup>2</sup>, J.M. VALLES, JR., Brown University Department of Physics, G. FERNANDES, J.M. XU, Brown University Division of Engineering — The Cooper Pair Insulator (CPI) phase has been observed in a variety of systems close to both the disorder and field tuned Superconductor to Insulator Transition (SIT) in two dimensions. A number of recent experimental and theoretical studies suggest that the CPI phase arises due to inhomogeneities in the superconducting coupling constant on the nanoscale. Anodized Aluminum Oxide (AAO) substrates provide a convenient experimental platform for studying the influence of inhomogeneity on the CPI state, as the substrates exhibit both a nanohoneycomb structure which allows flux periodic behavior to be measured, as well as a controllable morphology which permits control of the level of inhomogeneity present. We will discuss recent experiments and analyses which examine the behavior of the CPI phase as the level of inhomogeneity in the films is reduced. We will also examine the potential implications of this work in understanding the extent of the CPI phase in two-dimensional systems. This work was supported by the NSF through grants No. DMR-1307290 and DMR-0907357 and by the AFRL, the ONR, and the AFOSR.

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