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Shrinking of the Cooper Pair Insulator Phase in Thin Films with Ultrasmall Superconducting Islands J.C. JOY, X. ZHANG, C. ZHAO[1], J.M. VALLES, JR., Department of Physics- Brown University, G. FERNANDES, J.M. XU, Division of Engineering- Brown University — The ubiquity of the bosonic Cooper Pair Insulator (CPI) phase near the two-dimensional superconductor to insulator transition (SIT) is a long standing question. While a number of two dimensional materials exhibit bosonic insulating phases similar to the Mott Insulator in arrays of ultrasmall, Josephson coupled superconducting islands, others show behaviors consistent with a fermionic insulating phase. Utilizing specially prepared anodized aluminum oxide substrates, we are able to fabricate films reminiscent of arrays of superconducting islands whose properties are tunable by varying the substrate morphology. Our recent work has focused on arrays of islands which possess an energy level spacing comparable to the mean field superconducting gap, where one expects pair breaking followed by fermionic Anderson Localization as the dominant mechanism by which superconductivity is destroyed. Early results show that the paradigmatic bosonic insulator exists only very near the disorder tuned SIT, while films only marginally deeper in the insulating phase exhibit transport distinct from the CPIs reentrant, activated transport. We are grateful for the support of NSF Grant No. DMR-1307290, the AFOSR, and the AOARD.

[1]Currently at Northwestern Polytechnical University, Xian, China

James Joy
Brown University

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