Nonlinear Transport at the Superconductor-Insulator Transition in Thin TiN Films

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We investigate experimentally the electronic transport at the insulating side of the superconductor to insulator transition in thin TiN films. At temperatures $T > 50$ mK we observe an Arrhenius-type conductance, with an activation energy depending logarithmically on the sample size. At high bias the current voltage (I-V) characteristics display a large current jump into an electron heating dominated regime. For the largest samples (area > 100 μm x 100 μm), and below 50 mK we observe a low-bias power law $I \propto V^{\alpha}$ characteristics with an exponent $\alpha > 1$ rapidly growing with decreasing temperature, which is expected for a binding-unbinding crossover of the charge-Berezinskii-Kosterlitz-Thouless type. A competing interpretation in terms of electron heating is investigated and also yields strong evidence for the formation of an unusual insulating state at ultra-low temperatures.