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Are "pinholes" the cause of excess current in superconducting tunnel junctions? A study of Andreev current in highly resistive junctions[1] MARKKU STENBERG, TINE GREIBE, CHRISTOPHER WILSON, THILO BAUCH, VITALY SHUMEIKO, PER DELSING, Chalmers University of Technology — In highly resistive superconductor—insulator—superconductor (SIS) and superconductor—insulator—normal-metal (SIN) junctions, "excess" subgap current is usually observed. We have studied subgap conductance in Al/AlO_x/Al and Al/AlO_x/Cu tunnel junctions. In the former, we observed a huge (two orders of magnitude) decrease in subgap conductance upon the transition from the SIS to the SIN regime. In the latter, we observed several signatures of coherent diffusive two-particle transport. We use the quasiclassical Keldysh-Green function theory to quantify the contributions of the single- and two-particle processes on subgap conductance. Our observations indicate insignificance of highly transparent microscopic defects ("pinholes") in the tunneling barrier, and we therefore argue that the common "pinhole" scenario is not the explanation for the observed excess subgap current in SIS tunnel junctions.

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