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# JOSEPHSON JUNCTIONS WITH RESONANCE-PERCOLATING CHARGE TRANSPORT

In this work, we have proposed, realized and analyzed trilayered Josephson junctions with a resonance-percolation charge transport (see [1] about this) consisting of two superconducting electrodes made of MoRe alloy with a critical temperature of about 10 K separated by a silicon layer of thicknesses up to 30 nm doped by tungsten with 4 - 12 at.%.
We have studied low-temperature (T=4.2 K) current-voltage charact of the junctions and revealed two novel important features, comparatively high characteristic voltages Vc=IcRn (Ic is the critical current and Rn is the normal-state resistance) up to 5 meV and even more which exceed theoretical estimates for a single Josephson junction and well-resolved Shapiro steps at voltage biases Vn = (h/2e)nf (n is an integer) in the presence of external microwave irradiation with the frequency f in the range from 0.5 to 20 GHz. Unusually high values of Vc and Vn in some samples can be explained by the presence of tens of junctions in series. We propose a simple theoretical formalism for charge transport across a set of resonance-percolating trajectories inside a nanometer-thick semiconducting films which is based on a distribution function of the transmission coefficient across a doped semiconducting interlayer.
The emergence of novel functionalities due to the disorder in doped nanometer-thick semiconducting films makes it possible to realize a trilayered junction with enhanced conductance properties and, at the same time, well separated metallic electrodes (see also [2]). We believe that it enables their use for various superconductive electronics applications including voltage standards.

[1] I.M. Lifshitz and V.Ya. Kirpichenkov. Sov. Phys. JETP 50, 499 (1979).
[2] A.L. Gudkov, M.Yu. Kupriyanov, and A.N. Samus'. JETP 114, 818 (2012).

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