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Cu-Nb nanofilamental superconducting wires and nanostructured alloys

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Recent advances in nanofabrication of superconducting nanowires provided excellent platforms for basic research and also test systems for applications of superconductors in confined geometries. Superconducting nanowires with diameters comparable to the superconducting coherence length become one-dimensional (1D) nanostructures that exhibit unique properties like, thermal and quantum phase slips, an "antiproximity effect", "row" vortex lattices, mini-gap state, resistance fluctuations, shape-dependent superconducting resonances and many others. In his report we present a cold plastic working fabrication method of Cu–Nb nanocomposites by means of multiple steps of compacting and drawing of Nb rods in Cu tubes. The number of wires in these composites increases in geometric progression during subsequent drawings, which results in reduction of Nb filament cross-section. In this way, wires with the diameter 150 m, having more than 820,000 niobium nanofilaments of a diameter between 100 and 200 nm and hexagonally distributed in a pure copper matrix were produced. The superconducting composites exhibited enhanced critical currents determined mainly by surface vortex pinning, critical temperature close to the bulk Nb and microwave absorption due to vortex lattice motion or phase slips at Nb-Cu-Nb Josephson junctions. Other superconducting wires were fabricated by cold plastic working of Cu–Nb alloys. The nanostructure of these Cu-Nb superconducting fine wires of a diameter 87 m was irregular with niobium particles of globular shape and narrow filaments of the niobium-rich phase. In spite of this drawback the wires derived from Cu–Nb alloys exhibited advantageous mechanical properties and relatively high electrical conductivity.

Biography

Bartłomiej Andrzejewski is an Associated Professor and Head of the Department of Ferroelectrics at the Institute of Molecular Physics Polish Academy of Sciences. His research interests focus on ferroelectrics, multiferroics, magnetic nanomaterials and on superconductivity. He teaches courses at the Institute of Molecular Physics and at Poznań University of Technology in solid state physics and superconductivity. He has published more than 100 peer-reviewed papers, and is a co-author of a few pending patent.

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