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Double Percolation Transition in Superconductor/Ferromagnet Nanocomposites XIANGDONG LIU, RAGHAVA P. PANGULURI, Department of Physics and Astronomy, Wayne State University, Detroit MI 48201, USA, DANIEL P. SHOEMAKER, Materials Department and Materials Research Laboratory,University of California,Santa Barbara, CA 93106-5121, USA, ZHI-FENG HUANG, BORIS NADGORNY, Department of Physics and Astronomy, Wayne State University, Detroit MI 48201, USA — A double percolation transition is identified in a binary network composed of nanoparticles of MgB_2 superconductor and CrO_2 half-metallic ferromagnet. Anomalously high-resistance or insulating state, as compared to the conducting or superconducting states in single-component systems of either constituent, is observed between two distinct percolation thresholds. We investigate the scaling behavior near both percolation thresholds, and determine the distinct critical exponents associated with two different types of transitions. This double percolation effect, which is especially pronounced at liquid helium temperatures, is controlled by composite volume fraction and originates from the suppressed interface conduction and tunneling as well as a large geometric disparity between nanoparticles of different species. This sensitivity of the threshold to the geometry is confirmed by replacing $CrO_2$with LSMO particles of different size and shape, which results in significantly different threshold for MgB_2.

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