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1D to 3D Crossover Transition in a System of Weakly Coupled Superconducting Nanowires QIHONG CHEN, MING YUAN SUN, ZHI LIN HOU, TING ZHANG, ZHE WANG, WU SHI, ROLF W. LORTZ, PING SHENG, the Hong Kong University of Science and Technology — Recent Results have shown the existence of superconductivity in quasi-one-dimensional systems, e.g., the 4Å superconducting carbon nanotubes embedded in the aligned, linear pores of the aluminophosphate-five (AFI) zeolite. In order to understand theoretically the experimental observations on the thermal specific heat and the electrical resistance variation as a function of temperature, we have carried out Monte Carlo simulations on a Ginzburg-Landau (GL) model of Josephson-coupled superconducting nanowires. The results show that the competition between 1D fluctuations and the weak transverse Josephson coupling between the nanowires can give rise to a 1D-3D crossover transition at a temperature T_C below the mean field T_C^O of the wires. The electrical resistance can experience a sharp drop at T_C, at which point the nanowires become phase coherent. The simulated specific heat exhibits a rounded peak between $T_C$and T_C^O, whereas the phase correlation length within the ab plane diverges at T_C from above, in a manner that is consistent with the occurrence of a BKT-transition in the ab plane. These Monte Carlo simulated behaviors are in excellent agreement with the experimental data.

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