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Finite-size scaling behavior and intrinsic critical exponents of nickel: Consistent with the three-dimensional Heisenberg model JUN WANG, WEI WU, FAN ZHAO, Ningbo University, GUO-MENG ZHAO, California State University, Los Angeles — We report high-temperature magnetic measurements of silica-coated nickel nanoparticles. The Curie temperature is found to decrease with decreasing particle size and follow a finite-size scaling relation with the correlation length exponent $\nu = 1.06 \pm 0.07$. The measured exponent is in excellent agreement with the reported values for nickel nanowires and some nickel thin films. By carefully analyzing the reported thickness dependencies of the Curie temperatures for some nickel films, we show that the intrinsic ν value for nickel is 0.73 ± 0.03 while the much larger ν values (about 1.0) found for some other samples might arise from the presence of long-range correlated disorder near the surface. The intrinsic ν value together with the experimental values of other critical exponents consistently shows that the three-dimensional Heisenberg model is sufficient to describe the ferromagnetism of nickel. Our current work thus resolves a long standing controversy in this field.

Guo-meng Zhao
California State University, Los Angeles

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