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Percolation transition in nanowire magnetorheological fluids[1]
JOSH KARLI, DARIN ZIMMERMAN, JOSEPH FILER, RICHARD BELL, The Pennsylvania State University, Altoona, NORMAN WERELEY, The University of Maryland — We measure the yield stress of magnetorheological (MR) fluids that employ cobalt nanowires as the ferromagnetic component and observe a percolation transition in the yield stress at a critical value of the cobalt-nanowire volume fraction, p_c. The critical volume fraction depends not only on the particle size and aspect ratio (as expected) but also on the external magnetic field applied to the MR-fluid sample. We fit the yield-stress data using McLachlan's generalized effective medium (GEM) model to determine p_c and the percolation exponents s and t that describe the transition behavior below and above p_c, respectively. The phase transition from low- to high-yield stress at low magnetic-particle volume fraction ($< 1\%$) has potential application to the development of precision magnetic sensors and actuators.

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