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The Giant Electrorheological Effect in Suspensions of Nanoparticles

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Electrorheology (ER) denotes the control of material's flow properties (rheology) through electric field. We have fabricated ER suspensions of coated nanoparticles that exhibit electrically controllable liquid-solid transitions in which the solid state can reach a yield strength of 130 kPa, breaking the theoretical upper bound on conventional ER static yield stress that is derived on the general assumption of linear dielectric and conductive responses of the component materials. This giant electrorheological (GER) effect displays near-linear variation of the static yield stress versus the electric field, in contrast to the quadratic variation usually observed. Our GER suspensions display low current density over a wide temperature range of 10–120°C, with a reversible response time of <10 ms. Finite element simulations, based on the model of saturation surface polarization in the contact regions of neighboring particles, yield predictions in excellent agreement with the experiment. *W. Wen, X. Huang, S. Yang, K. Lu, Ping Sheng, Nature Materials 2, 727-730 (2003).

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