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Supplementary Information for

Enhanced electrorheological performance of graphene oxide-wrapped silica rod with high aspect ratio

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1. Fabrication of graphene oxide (GO) nanosheet

Nanometer-sized GO was fabricated by using a ball-mill process. The specific and detailed procedure for fabricating GO nanosheet was described in experimental section. The size of prepared GO nanosheet was confirmed as *ca.* 100 nm by TEM analysis (Fig. S1).

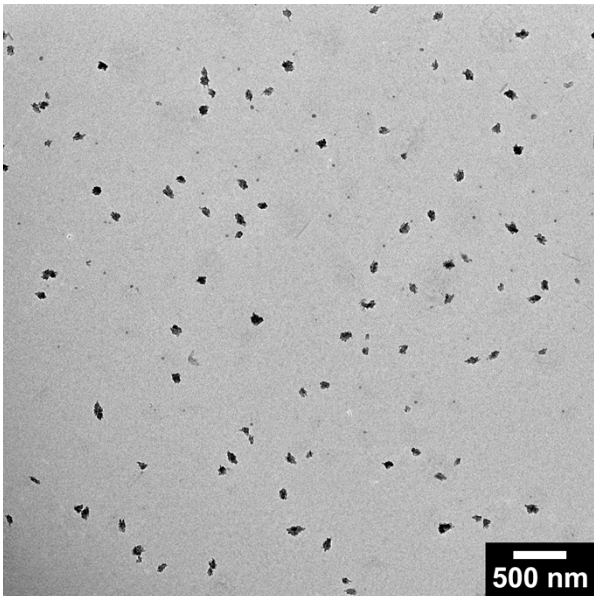

Fig. S1 TEM image of GO nanosheet (diameter: *ca.* 100 nm) prepared by a ball-mill process.

2. Electrorheological (ER) response of various silica material-based fluids

The rheology and the ER response of various bare silica material-based fluids were measured (Fig. S2). Without an electric field, the shear stress of various silica material-based fluids increased in proportion to the shear rate, which represents typical Newtonian behavior (Fig. S2a). In general, fluids can be classified into two categories, Newtonian and non-Newtonian fluid. The Newtonian fluid is a fluid that has a linear relation between shear rate and shear stress. In the non-Newtonian fluid, however, the relation between shear rate and shear stress is non-linear, and the non-Newtonian fluid can be classified into three categories; shear thinning, shear thickening, and Bingham fluid. A Bingham fluid is a fluid that the shear stress proportionally increases until critical shear rate and exhibits Newtonian behavior beyond the critical shear rate.[1] When the electric field was applied, the shear stress of silica material-based fluids exhibited non-Newtonian behavior (typically, Bingham plastic behavior) as shown in Fig. S2b. The shear stress value of silica material-based ER fluids was much lower than that of GO-wrapped silica material-based ER fluids under identical condition. It can also be found that the shear stress of the ER fluids increased with increasing the aspect ratio of silica materials. In addition, the shear viscosity of the silica material-based ER fluids decreased as the shear rate increased, which was in accordance with the shear thinning behavior. To examine the real-time response of silica materials, the change of shear stress was investigated while the electric field was alternately turned on and off (Fig. S2c). The reproducibility and reversibility were confirmed by repeating the cyclical application of the electric field.

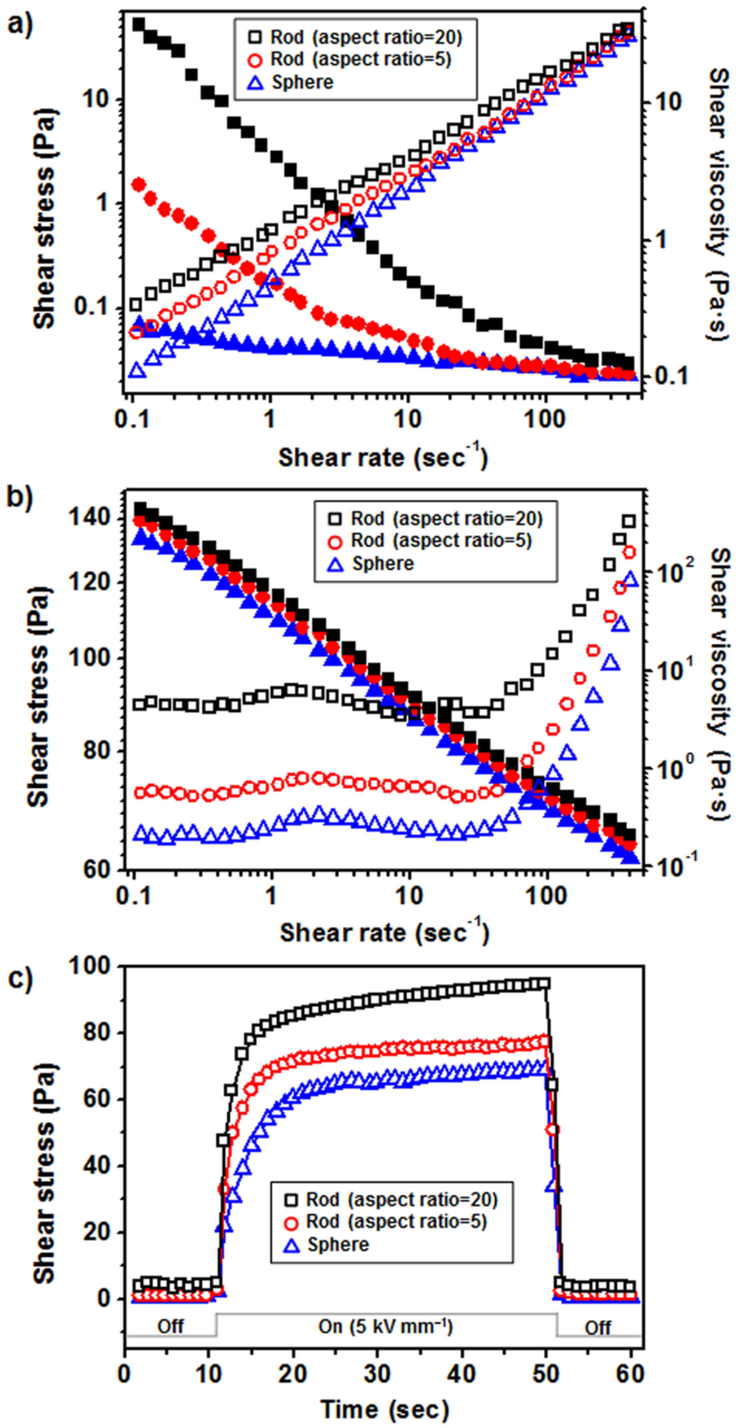

Fig. S2 Shear stress (open symbol) and shear viscosity (close symbol) of various silica materials-based ER fluids (5.0 wt% in silicone oil) a) without the electric field, and b) under 5 kV mm^{-1} of electric field. c) Effect of switching the applied electric field on the shear stress of various silica materials-based ER fluids (5.0 wt% in silicone oil).

3. Reference

1 K. T. Manish, V. B. Alexander, L. Y. Alexander, M. M. Constantine, *Rheol. Acta.*, 2009, **48**, 597.