SUPPLEMENTARY INFORMATION

Tuning magneto-rheological properties of magnetic fluid using hydrophilic fumed silica nanoparticles

by

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1. The volume fraction of the magnetic fluid

The volume fraction of the magnetic fluid we used is 13.98%. We calculate the volume fraction according to the saturation magnetization of magnetic fluid and magnetic particles (prepared by co-precipitation method, then dry and grind). As shown in Fig. S1, the saturation magnetization of the magnetic particles is 3834.01 Gauss, and the magnetic fluid is 536.05 Gauss (the density of the magnetic fluid is 1.26g/cm^3). Therefore, we can get that the volume fraction of magnetic particles in the magnetic fluid is 13.98%.

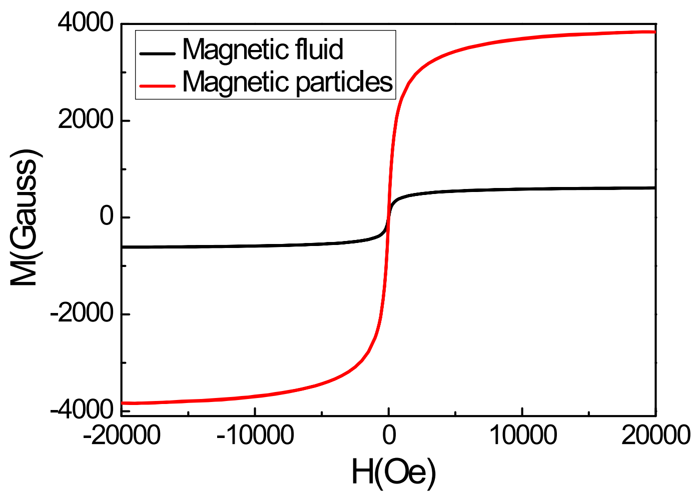

Fig. S1 The magnetization curves of magnetic fluid and magnetic particles.

2. The static yield stress of magnetic fluid with 0.05wt.% silica nanoparticles and magnetic fluid with 0.15wt.% silica nanoparticles

The static yield stress of magnetic fluid with 0.05wt.% silica nanoparticles and magnetic fluid with 0.15wt.% silica nanoparticles is shown in Fig. S2 and their exponents are 0.41 and 0.44 respectively.

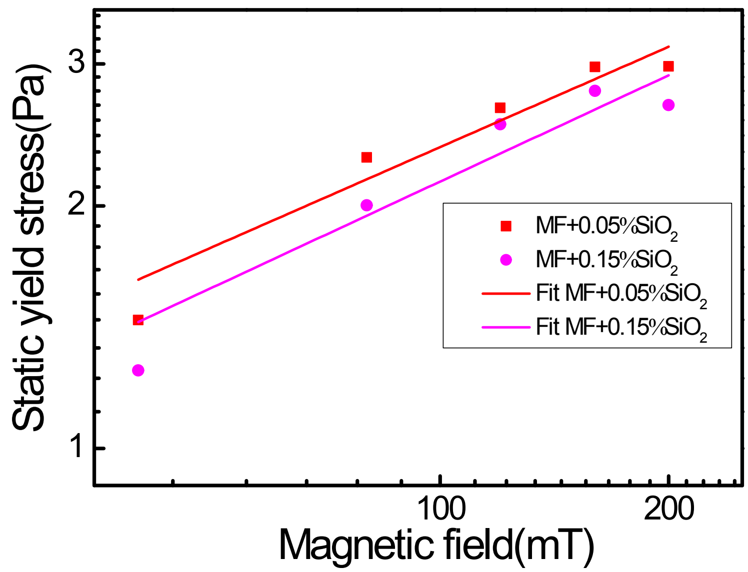

Fig. S2 The static yield stress of magnetic fluid with 0.05wt.% silica nanoparticles (MF+0.05%SiO_2) and magnetic fluid with 0.15wt.% silica nanoparticles (MF+0.15%SiO_2) under different magnetic field

3. Mason number curves of magnetic fluid with 0.05wt.% silica nanoparticles and magnetic fluid with 0.15wt.% silica nanoparticles

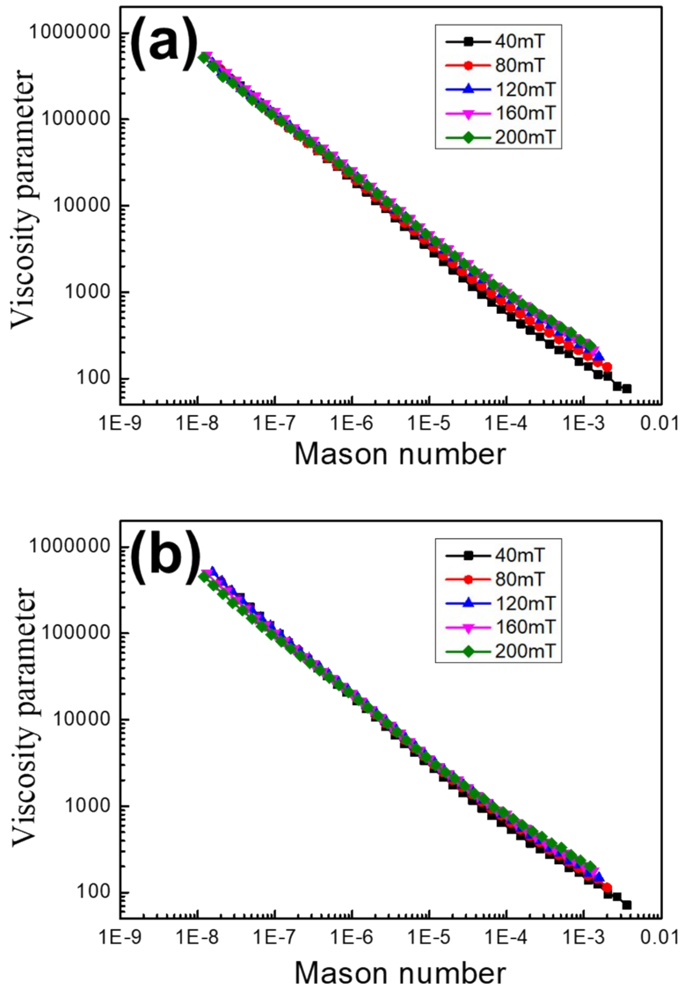

Fig. S3 The relationship between the dimensionless viscosity parameter N and the Mason number (a) magnetic fluid with 0.05wt.% silica nanoparticles (b) magnetic fluid with 0.15wt.% silica nanoparticles

4. A higher magnification TEM image and element EDS mapping of magnetic fluid with silica nanoparticles

We provide better insights into the role of silica in the structure formation. In order to further illustrate the validity of coarse-grained calculations, a higher magnification TEM image and element EDS mapping better reveal the role of silica nanoparticles in structure formation, as shown in Fig. S4. To further reveal the distribution of magnetic nanoparticles and silica nanoparticles, the corresponding EDS mapping is performed as shown in Fig. S4(b) (c) (d), where (b) shows the elemental distribution of O/Fe/Si, (c) shows the elemental distribution of Si, (d) shows the elemental distribution of Fe. The mapping indicates that hydrophilic silica nanoparticles form network structures and magnetic nanoparticles is distributed in the silica structures. The silica network structures between the magnetic particles prevent magnetic nanoparticles from forming field-induced structures under magnetic field. Therefore, the silica nanoparticles will reduce the size of the field-induced structures of the magnetic fluid.

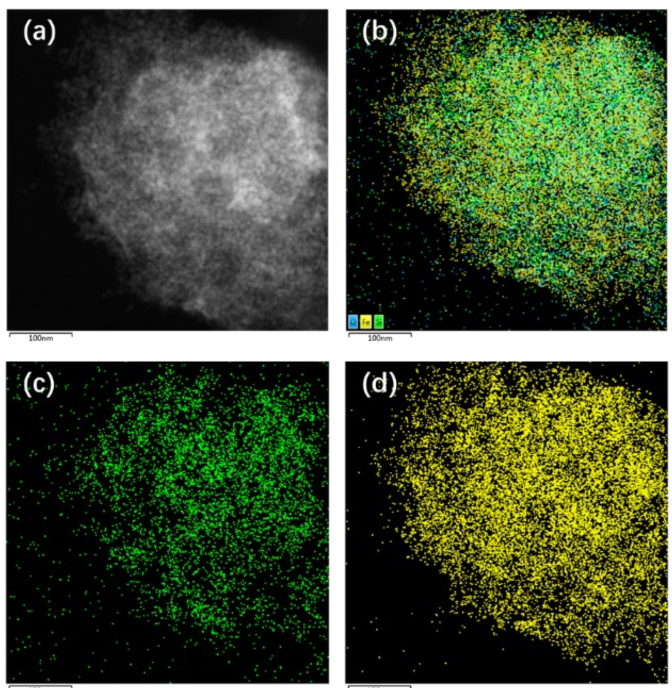

Fig. S4 (a) A higher magnification TEM image of magnetic fluid with hydrophilic silica nanoparticles (b) EDS mapping of the elemental distribution of O/Fe/Si (c) EDS mapping of the elemental distribution of Si (d) EDS mapping of the elemental distribution of Fe.