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Supporting Information for

Electrorheological performance of multigram-scale mesoporous silica particles with different aspect ratios

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XRD patterns of various $mSiO_2$ nanomaterials

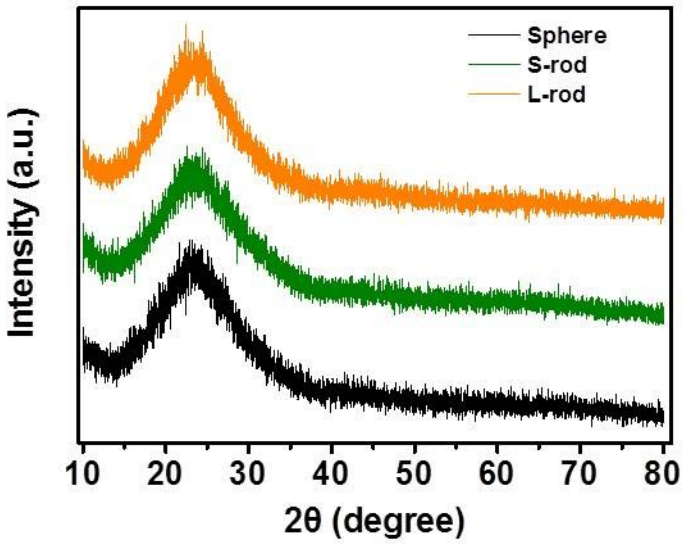

Fig. S1 XRD spectra of various $mSiO_2$ nanomaterials.

X-ray diffraction (XRD) patterns of the $mSiO_2$ materials were used to determine the phase of the material. Weak broad peaks were detected for all samples between 20° and 30°, which indicated the amorphous phase of the material. This result suggests that three kinds of $mSiO_2$ nanomaterials were fabricated without any crystallinity.

FT-IR spectra of various $mSiO_2$ nanomaterials

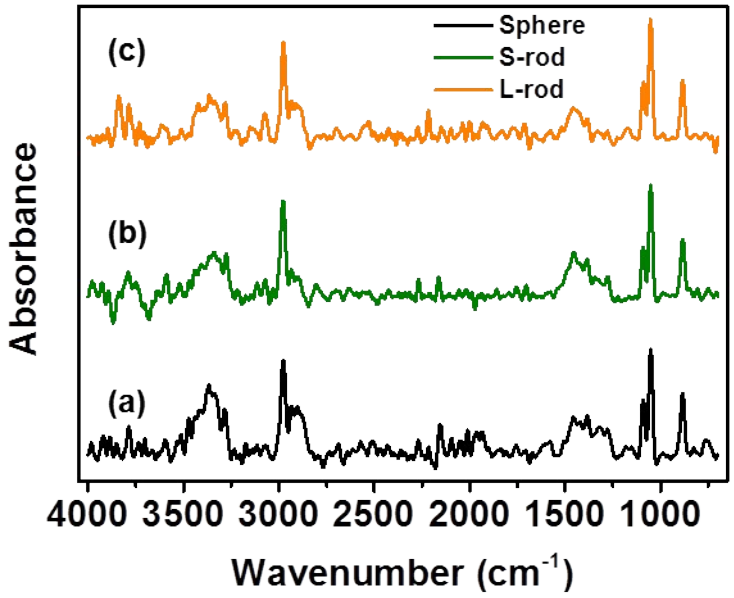

Fig. S2 FT-IR spectra of a) sphere, b) S-rod, and c) L-rod $mSiO_2$ materials, respectively.

The FT-IR spectra data of three $mSiO_2$ showed characteristic peaks of SiO_2, including Si–O–Si asymmetric stretching located at 1100 cm^{-1}, Si–O stretching vibrations at near 1080–1050 cm^{-1}, and Si–O bending near 900 cm^{-1}. Moreover, peaks for water molecules were detected from the samples. In specific, all samples displayed O–H stretching frequency near 3850–3780 cm^{-1}, broad –OH stretch peak near 3400 cm^{-1}, and weak H–O–H bending at 1650 cm^{-1}. Also, C–H stretching vibration peaks and CH_2 scissoring mode vibration peaks were detected near 2980 cm^{-1} and 1460 cm^{-1}, respectively. These carbon-related characteristic peaks were originated from the remaining CTAB surfactants. Considering these results, some water molecules and organic species were left in the samples even after the calcination and drying process. Such results might be ascribed to the presence of numerous pores and internal void created within $mSiO_2$ samples, which hindered the complete loss and combustion of organic and water molecules during the drying process.

EDS elemental analysis of three $mSiO_2$ samples.

Table S1 EDS analysis of three kinds of $mSiO_2$ materials[a]

Sample	Si (atomic%)	O (atomic%)	C (atomic%)
Sphere	29.31	69.47	1.22
S-rod	28.99	69.81	1.20
L-rod	29.32	68.88	1.80

[a] Atomic weight percent was acquired by EDS mode with 45 s, 10 μA of beam current, and 10 kV of accelerating voltage.

To gain more insight into the composition of leftover water and organic molecules, we have examined the atomic compositions of $mSiO_2$ samples with EDS analysis. As a result, there is an existence of excess amounts of O (without formation of SiO_2) and C compositions. Judging from this result, there is some moisture and organic species remained in three $mSiO_2$ samples to induce the interfacial polarization and resulting ER activity under the applied electric field. Furthermore, these leftover species may be increased the conductivity of samples to induce the conductivity mismatch between particle and oil, which also contributed to the ER effect. It was noticeable that the amounts of all atomic compositions (Si, O, and C) were similar for all samples. In other word, differences in ER activity of various $mSiO_2$ materials were mostly affected by the variation in aspect ratio.

Zero-field ER activity of various $mSiO_2$-based ER fluids

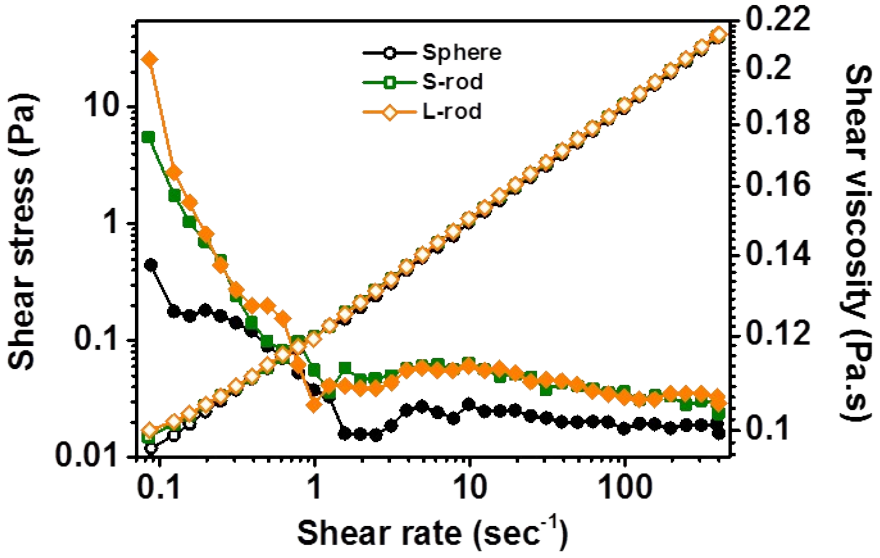

Fig. S3 Zero-field shear stress (open symbol) and shear viscosity (closed symbol) of various $mSiO_2$-based ER fluids (3.0 wt%) as a function of shear rate.

The zero-field ER activity of various $mSiO_2$-based ER fluids were investigated to provide more rheological data of materials. Firstly, all shear stress values of three kinds of $mSiO_2$-based ER fluids increased with increasing shear rate, which corresponded to the typical Newtonian fluid behavior. Since there was no applied electric field, shear stress values of samples showed small difference. However, L-rod $mSiO_2$-based ER fluid exhibited slightly high shear stress compared to S-rod- and sphere-based ER fluids. This phenomenon is attributed to the increased flow resistance of high aspect ratio materials to exhibit increased shear stress against the hydrodynamic force. Under the same condition, the zero-field shear viscosities of samples decreased with increasing shear rate to manifest the typical shear thinning behavior.