Supporting Information

1. Sulfhydryl modification of SiO$_2$ microspheres

First, SiO$_2$ was dried at 60 °C, and 20 g of the dried sample was added to a beaker. Subsequently, an appropriate amount of anhydrous ethanol was added and ultrasonically dispersed for 30 min. MPTMS (5 g) was added to the dispersed SiO$_2$ suspension, and the mixture was mechanically stirred at 70 °C for 6 h. Subsequently, the reaction suspension was centrifuged with anhydrous ethanol, washed three times, and dried at 60 °C to obtain sulfhydrylated surface-modified SiO$_2$ microspheres.

2. SiO$_2$@Ag experimental protocols for microspheres and STF

The experimental protocols for preparing SiO$_2$@Ag composite core-shell microspheres are listed in Table S1.

The experimental protocols for the preparation of single-phase and two-phase STFs samples are listed in Table S2.

Photos of the synthesized single-phase and two-phase STFs samples are shown in Figure S1.

Table S1 Experimental protocols for SiO$_2$@Ag core-shell microsphere synthesis

| Sample	Silver nitrate /mol/L	NH$_4$OH	c（NaOH）/mol/L	c（C$_6$H$_{12}$O$_6$）/mol/L
N$_3$C$_9$			0.03	
N$_{11}$C$_9$			0.11	
N$_{15}$C$_9$			0.15	0.09
N$_{19}$C$_9$			0.19	
N$_{23}$C$_9$	0.12	appropriate amount	0.23	
N$_7$C$_3$				0.03
N$_7$C$_5$				0.05
N$_7$C$_9$			0.07	0.09
N$_7$C$_{11}$				0.11
N$_7$C$_{13}$				0.13

Note: In the study, 10 types of reducing solutions with different concentration ratios of NaOH and $C_6H_{12}O_6$ were selected to prepare $SiO_2@Ag$ core-shell microspheres. The sample codes were denoted as NxCy, where X and Y represent the concentration ratios of NaOH and $C_6H_{12}O_6$, which were 0.01x and 0.01y mol/L, respectively. For example, N_3C_9 indicates that the concentration of NaOH and $C_6H_{12}O_6$ in the reducing solution is 0.03 and 0.09 mol/L, respectively.

Table S2 Composition of different STFs samples

Sample	SiO_2（%）	$SiO_2@Ag$（%）	PEG200（%）
STF_{61}	61		39
STF_{63}	63		37
STF_{65}	65	0	35
STF_{67}	67		33
STF_{69}	69		31
STF_{70}	70		30
$STF_{40:25}$	40	25	
$STF_{45:20}$	45	20	
$STF_{50:15}$	50	15	31
$STF_{55:10}$	55	10	
$STF_{60:5}$	60	5	

Note: In this study, $STF_{x:y}$ was used to describe the ratio of SiO_2 and $SiO_2@Ag$ in the STFs system. For example, $STF_{45:20}$ indicates that the mass fraction of SiO_2 and $SiO_2@Ag$ are 45% and 20%, respectively.
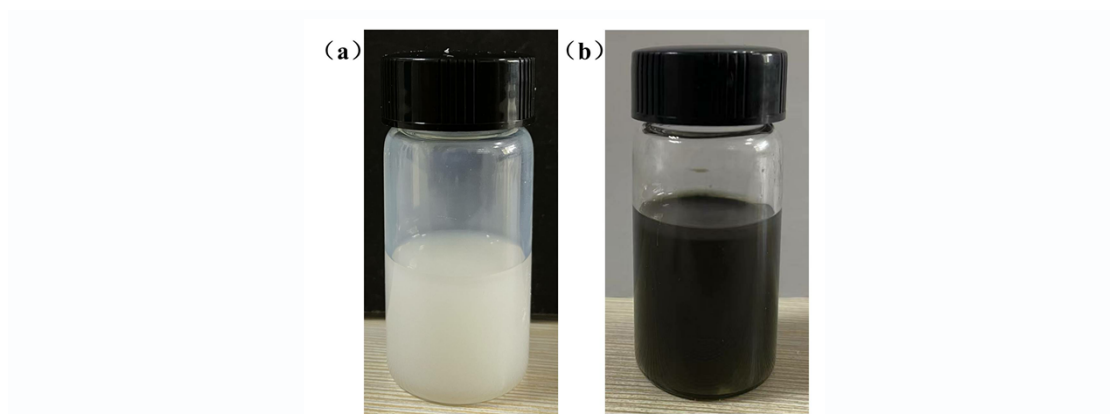
Figure S1. (a) Single-phase STFs and (b) two-phase STFs

3. Rheological properties of the single-phase STFs system

3.1. Effect of SiO_2 concentration on the steady-state rheological properties of the
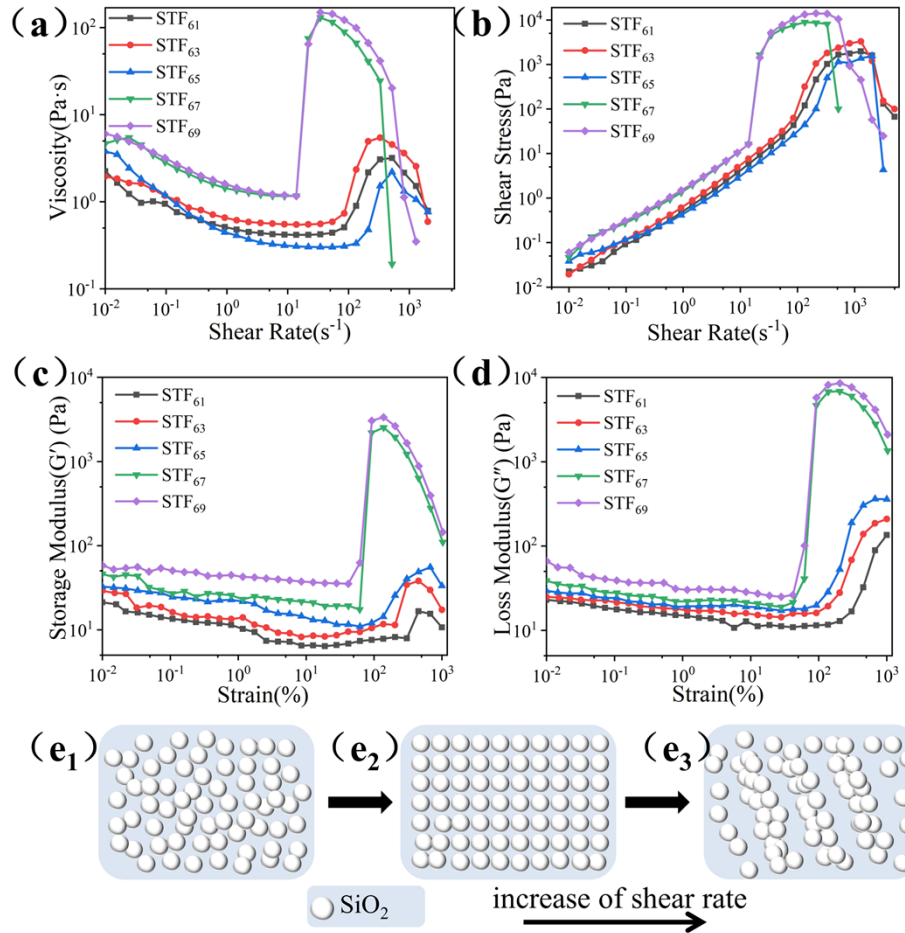
single-phase STFs system

The relationship between the shear rate, viscosity, and shear stress, and the mechanism of the single-phase STFs system are shown in Figures S2 (a–e). Under different SiO_2 concentrations, the viscosity growth trend of the STFs system was mainly the same. The viscosity of the system initially decreased with increasing shear rate, resulting in the "shear thinning" phenomenon. However, when the critical shear rate was reached, the viscosity of the system increased rapidly, exhibiting the "shear thickening" phenomenon. Additionally, with increasing SiO_2 content in the system, the shear thickening behavior of STF became increasingly more significant, and the phenomenon of continuous shear thickening (CST) changed to discontinuous shear thickening (DST). However, the SiO_2 mass fraction did not increase indefinitely. When the SiO_2 mass fraction was 70%, the STF system was similar to a solid and could not be tested for rheology. It can be seen from the figure that the mass fraction of SiO_2 is 69%, which means the best thickening effect of STFs. When the SiO_2 mass fraction was 55%, the viscosity increased from 0.227 to 0.459 Pa·s at the critical shear rate, and the thickening rate was only 202%. When the SiO_2 mass fraction increased to 69%, the thickening rate was 12931%, exhibiting the best shear thickening effect.

The thickening phenomenon occurs because there is a large amount of silanol (Si-OH) groups on the SiO_2 surface. When SiO_2 is mixed with the dispersive medium PEG200, Si-OH combines with -OH in the dispersive medium PEG200 to form hydrogen bonds, which results in a stable network structure[11]. When the shear rate of the system is low, the fluid repulsive force and Brownian motion are mainly responsible

for the effect. With a continuous increase in the shear rate, the original disordered structure is degraded and forms a certain ordered arrangement, thereby resulting in a decrease in viscosity, as shown in Figures S2 (e1)–(e2). As the shear rate increases, the force between the particles gradually changes from fluid repulsion and Brownian motion to fluid force, and the interactions between particles become dominant. Therefore, the particles in the system form "hydroclusters" and the viscosity of the system increases, as shown in Figures S2 (e2)–(e3).

Figure S2 (b) shows that at low shear rates, the shear stress was linearly related to the shear rate. When the critical shear rate was reached, the shear stress increased rapidly, exhibiting nonlinear growth. Notably, STF_{67} and STF_{69} exhibited the most significant increase. The critical shear stress of STFs with different SiO_2 concentrations exhibited minimal variation. However, the critical shear stress of STFs with higher SiO_2 content was larger, and the critical shear rate was smaller.

The relationship between strain and the energy storage modulus (G') and loss modulus (G") of the single-phase STFs system is shown in Figures S2 (c) and (d). The overall trend of the curve of the STFs system was consistent. Under relatively small strain levels, G' and G" remained unchanged, and with increasing strain, both G' and G" curves exhibited a downward trend, which indicates shear thinning. After the critical strain was reached, the STFs system was mainly dominated by fluid force, which resulted in the rapid formation of hydroclusters, and therefore, the G' and G" curves increased. Notably, G" was larger than G' in this case. Thus, G" is dominant, indicating that the system exhibits viscous behavior.

Figure. S2. Relationship between shear rate and (a) viscosity and (b) shear stress of the single-phase STFs system. Relationship between strain and the (c) energy storage modulus G' and (d) loss modulus G" at 25°C, and (e) the mechanism diagram