Supplementary Information

1. Materials Supplementary Information

The molecular formula of each component of the non-aqueous conductive liquid is shown in Chart 1(a)-(b). The molecular formula of each component of the non-aqueous insulating liquid is shown in Chart 1 (c)-(d).

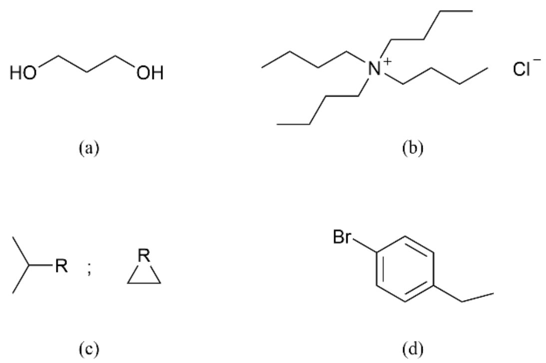

Chart 1 The molecular formula of the constituent substances of the proposed electrowetting liquids. (a) Propan-1,3-diol. (b) TBAC. (c) C14-C19, isoalkanes, and cyclic alkanes. R is hydrocarbon chain. (d) 1-Bromo-4-ethylbenzene.

In this paper, Fig. 2 and Fig. 3 show the relationship between the density and refractive index of biphasic liquids and the concentration and density of each component. More detailed data are given in Fig. S1 ~ S4.

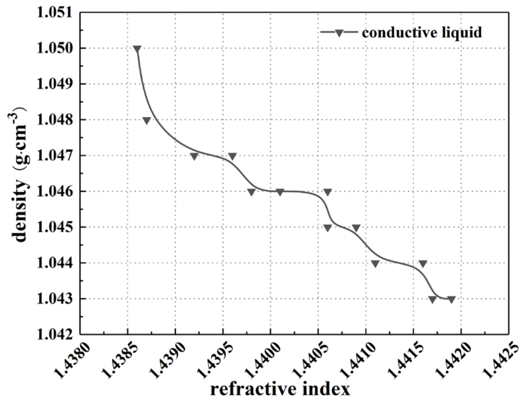

Fig. S1 Relationship between the density and refractive index of the conductive liquid.

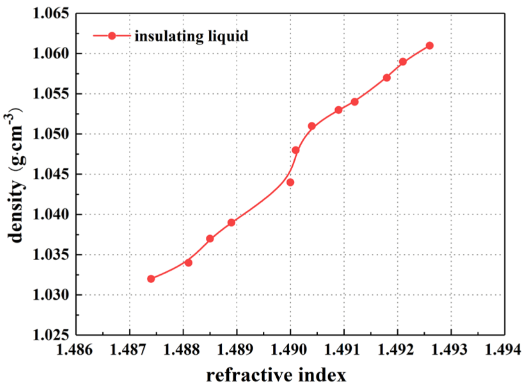

Fig. S2 Relationship between the density and refractive index of the insulating liquid.

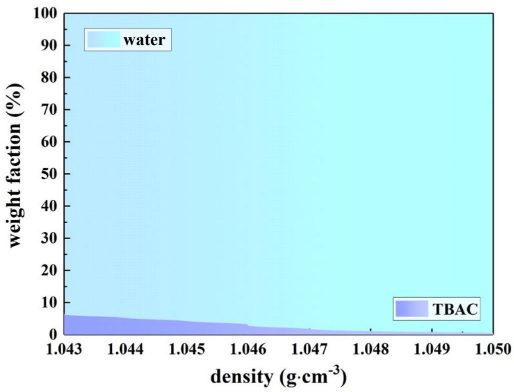

Fig. S3 Relationship between the concentration of TBAC and density of the conductive liquid.

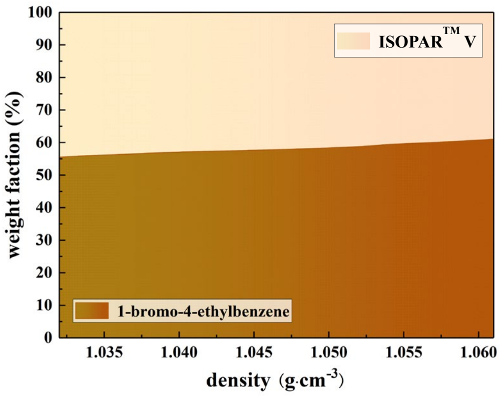

Fig. S4 Relationship between the concentration of 1-bromo-4-ethylbenzene and density of the insulating liquid.

2. One non-aqueous conductive liquid drop actuating experiment on a planar electrode

We put one conductive liquid drop on the plate copper structure coated with the dielectric layer and hydrophobic layer and inserted another needle electrode into the conductive liquid drop. Then we observe the contact angles of one non-aqueous conductive liquid drop on a planar electrode structure under different applied voltages (1.5kHz AC) through the platform of the contact angle measuring instrument (Type of JCY-2, Shanghai Fangrui Instruments Co., Ltd., China). This contact angle measuring device contains a

CCD camera and measurement software. In the initial state, the contact angle is ~100°. As the voltage increases, the contact angle decreases. When the applied voltage is 80V, the contact angle is ~41°.

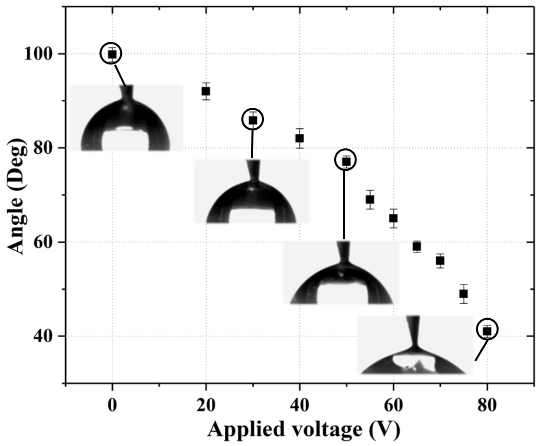

Fig. S5 Contact angle of one non-aqueous conductive liquid drop on a planar electrode structure under different applied voltages.

3. Fabrication process of the SELL

The fabrication procedure of the SELL is shown in Fig. S6. All conductive components of the SELL are made of copper. The spherical chamber (radius of the sphere 5 mm, the diameter of the clear aperture 8 mm) is coated with a dielectric layer (Parylene C, dielectric constant ~3.15, thickness ~3 μm) and a hydrophobic layer (Teflon AF 1600, thickness ~30 nm), as shown in Fig. S6(a). The coating process of Parylene C is chemical vapor deposition (CVD). Firstly, the coating process is: firstly, Parylene C raw material particles and spherical chamber are placed in an evaporation furnace. Under the condition of vacuum and high temperature of 150℃, the solid Parylene particles were transformed into gas. Then, under the action of high temperature of 650-700 ℃, the gaseous raw materials are cracked into reactive monomers. Finally, the gaseous monomer is deposited and polymerized on the surface of the spherical chamber at room temperature at nanometer speed.

The surface of the lower electrode is coated with insulating paint to isolate it from the upper electrode. Then, the lower electrode is cemented with the spherical chamber and lower cover glass by glue UV-339, as shown in Fig. S6(b). The upper electrode and the lower electrode are both provided with annular conductive areas, which are prepared for connecting with the press ring electrodes. Based on the radius and height of the chamber, we calculated the volume. We then used a pipette gun to inject the first half of the chamber volume with conductive liquid (the propane-1,3-diol containing TBAC), followed by the other half with insulating liquid (the isomeric alkanes containing aryl halide). In this way, the volume ratio of the two liquids is controlled as 1.0. We immerse the SELL in an environment filled with the isomeric alkanes containing aryl halide and put the upper cover glass on it, as shown in Fig. S6(c). Then we use glue UV-339 to seal the SELL, as shown in Fig. S6(d). The actual components of the SELL are shown in Fig. S6(e). The top view of the actual fabricated SELL is shown in Fig. S6(f). We also fabricate a driver board for the SELL. The driver board can provide 1.5kHz AC with two channels, and the press ring electrodes are connected with the channels, as shown in Fig. S6(g). The complete SELL connected with the press ring electrodes is shown in Fig. S6(h).

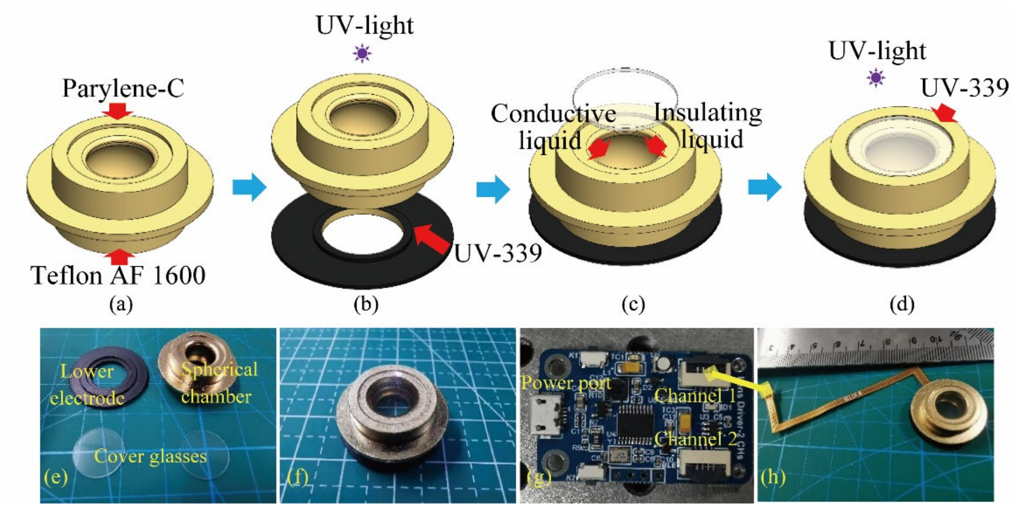

Fig. S6 Fabrication process of the SELL. (a) Dielectric layer and hydrophobic layer coated on the spherical chamber. (b) Lower electrode, lower cover glass, and spherical chamber cemented together. (c) Injecting the conductive liquid and the insulating liquid and covering the upper cover glass. (d) Sealing process of the SELL. (e) Actual components of the SELL. (f) Top view of the actual fabricated SELL. (g) Driver board for the SELL. (h) Complete SELL connected with the press ring electrodes.

4. Comparison of parameters between the SELL and Corning® Varioptic® Lenses

Table S1 Comparison of parameters between the SELL and Corning® Varioptic® Lenses (A-58N and A-39N)

TYPE	SELL	A-58N	A-39N
Aperture size(mm)	8.0	5.8	3.9
Optical power @ 0V(m^{-1})	-12	-13	-15
High optical power (m^{-1})	+14	+10	+15
Voltage @ 0 diopter (V)	55	42	42
Threshold voltage (V)	12	23	23
Transmission @ 587nm (%)	91	97	97