

Supplementary Information

Material fabrication

PNIPAM nanogel fabrication. The preparation of PNIPAM is as following: 1) the monomer NIPAAm (0.2 g) and crosslinker N,N-methylenebisacrylamide (4.0 mg) were first dissolved in distilled water to form a monomer solution (0.1 wt.%); 2) the mixture was mildly shaken for a few minutes, and ammonium persulfate solution (4 mg) and N,N,N,N-tetramethylethylenediamine (20 μ l) were added into the monomer solution to initiate radical polymerization, which was carried out in a glass bottle at room temperature (65 °C) for 6 hours; 3) the obtained nanogel was dialyzed in distilled water for at least 48 h, and the water was refreshed every several hours in order to allow the residue to leach out.

Solution preparation. The desired concentrations were obtained by weighing the gel and the total aqueous solution using a balance with a resolution of 10^{-4} g. The obtained mass is translated into volume by being divided by the density.

Experimental method

Evaporation rate measurement was conducted in a well-controlled environment, in which the relative humidity was fixed at 25% with an accuracy of 2%, and flow speed was controlled at 0.03 m/s with an accuracy of 0.001 m/s. An evaporation vessel filled with polymer solution was placed on an electronic weighing balance with a resolution of 10^{-4} g, and the mass loss during evaporation was recorded periodically. It should be noted that the amount of polymer solution in the evaporating vessel was approximately 20 g, and during the experiment, only approximately 0.3 g of pure solvent evaporated each time. Thus, the polymer concentration change during evaporation is just about 1.5%, which can be ignored. For comparison, the evaporation rates of water were also measured. The results are presented as ratios of the evaporation rates of the solution to that of pure water.

Note 1. Evaporation rate derivation

The evaporation process is limited by the diffusion of water molecules from the water surface to atmosphere, thus the evaporation rate is in fact equivalent to the mass transport rate of vapor molecules in the diffusion layer. Taking the vapor pressure as distributing linearly in the diffusion layer, the diffusion rate, J , can be expressed in terms of the saturated vapor pressure, P_s , at the evaporating surface and the vapor pressure in the environment, P_∞

$$J = h_m M/R (P_s/T_s - P_\infty/T_\infty), \quad (S1)$$

where h_m is the mass transfer coefficient, and T_s and T_∞ are the vapor temperatures corresponding to P_s and P_∞ , respectively. For laminar flow (the Reynolds number $Re < 2320$, where $Re = ul/\nu$, u is the wind speed and is set to 0.03 m/s in our experiments, l is the characteristic length of the evaporation surface, and ν is the dynamic viscosity near the evaporating surface), $h_m = 0.664Re^{1/2}Sc^{1/3}D/l$, where Sc is the Schmidt number, and $Sc = \nu/D$. As for slow evaporation, T_s and T_∞ are almost equivalent. Thus Equation S1 can be simplified as

$$J = C (P_s - P_\infty) \quad (S2)$$

where $C = h_m M/(RT)$, presenting the mass-transfer coefficient.

Supplementary Figures

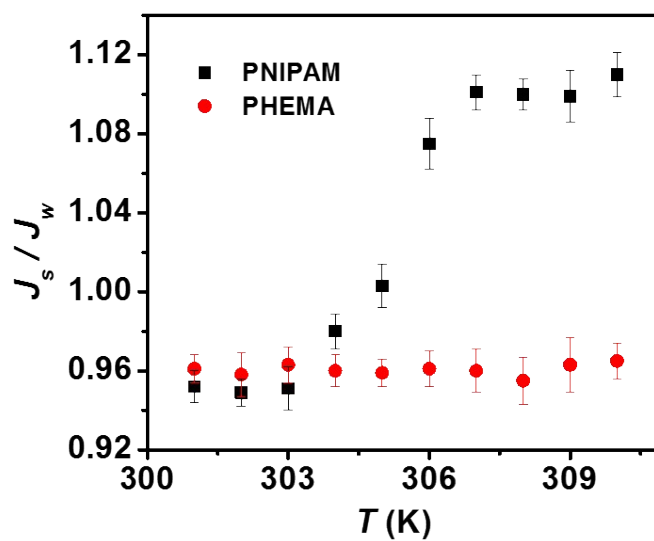


Figure S1. Evaporation ratios, J_s/J_w , of PNIPAM and PHEMA colloidal solutions as a function of the environmental temperature, T .

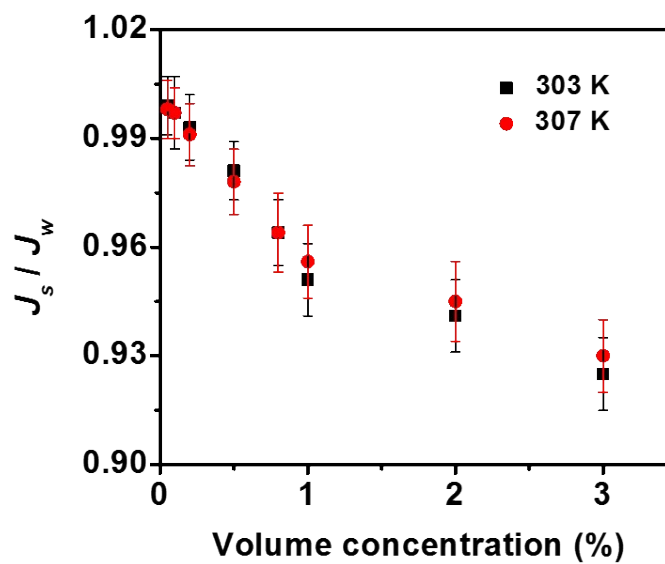


Figure S2. Experimental results of PHEMA colloidal solution evaporation rate ratios, J_s/J_w , with various volume concentrations at 303 K and 307 K.

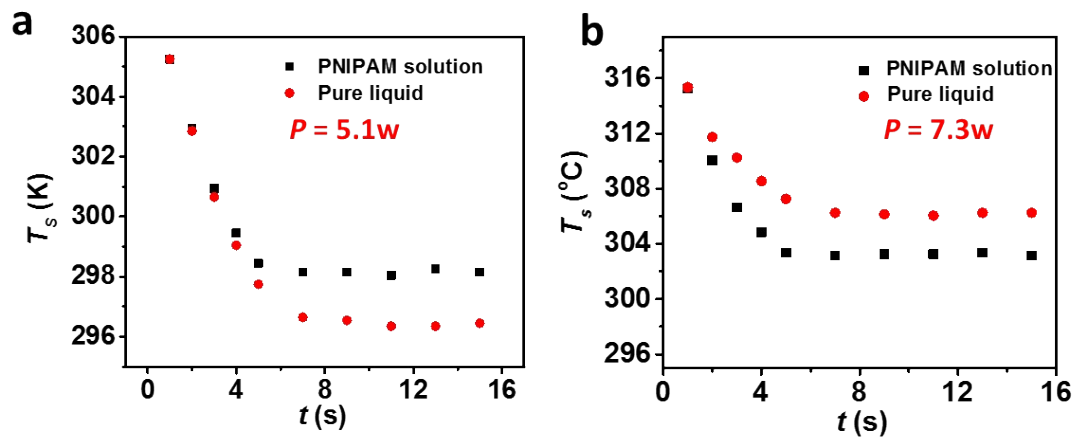


Figure S3. (a, b) Surface temperature variation of the device under different heating power P . The concentration of the colloid solution is 1% v/v.