Electronic Supplementary Information for the paper

Anti-icing properties of a superhydrophobic surface in a salt environment: unexpected increase in freezing delay time for weak brine droplets

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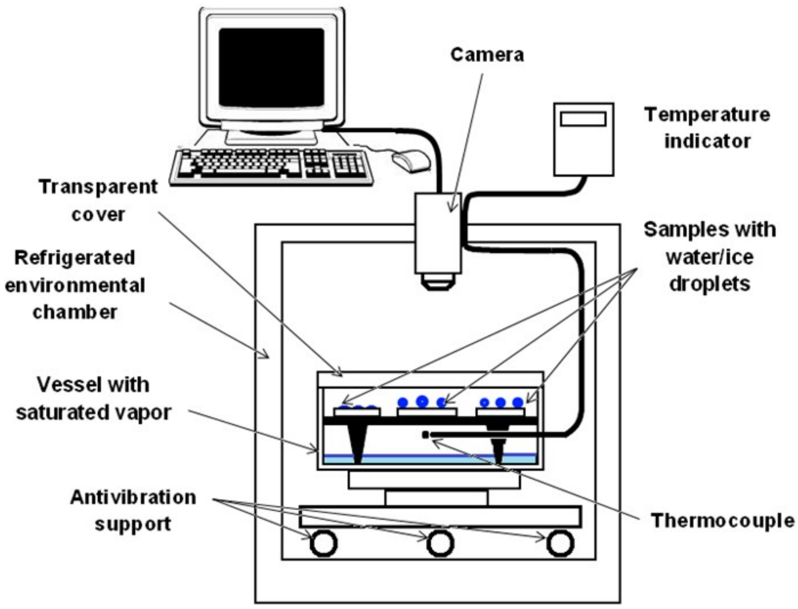

Figure S1. Schematic of the experimental setup for studying the nucleation kinetics.

In each freezing cycle, 60-70 sessile droplets with a volume of 18 μl were deposited on a patterned superhydrophobic substrate placed inside a thin-wall stainless steel hermetic cell with a transparent polymethyl methacrylate cover 2 cm thick (Figure S1). The low thermal conductivity of this cover prevents water from condensing on the inside of the cover in the presence of saturated water vapor. The transparent cover also makes it possible to monitor the phase state of droplets by analyzing the video sequence registered with a BestDVR-405 LightNet video system. Freezing of the droplets was detected by the change in appearance from clear to opaque (Figure S2).

The cell with substrates was placed on an antivibration support inside a Binder MK53 Environmental Chamber with temperature variations less than 0.3° (as indicated by the manufacturer). After droplets deposition, sealing the cell and equilibration of the vapor phase in the cell for 30 min, the temperature in the environmental chamber was lowered to the desired value over 15 minutes. The equilibrium temperature inside the cell was established by thermal exchange between the cell and the Environmental Chamber. The surface temperature of the superhydrophobic sample was registered with a DS1921 temperature sensor (Thermochron-RELSIB, Russia) with an accuracy of 0.5°C. The target temperature of the substrate surface (T= -20 °C) was usually achieved 60-90 min after starting the cooling cycle of the Environmental Chamber. The temperature in the system was kept constant for the remainder of the experimental run. The time elapsed from the instant the target temperature was reached on the sample surface until a given droplet froze was recorded as the freezing time delay for that droplet.

Figure S2. Still image of the experimental cell from the video recorder. A larger disk in the center of the image is the DS1921 temperature sensor. The difference in the appearance of supercooled liquid (bright) and crystallized (gray) droplets is clearly seen.

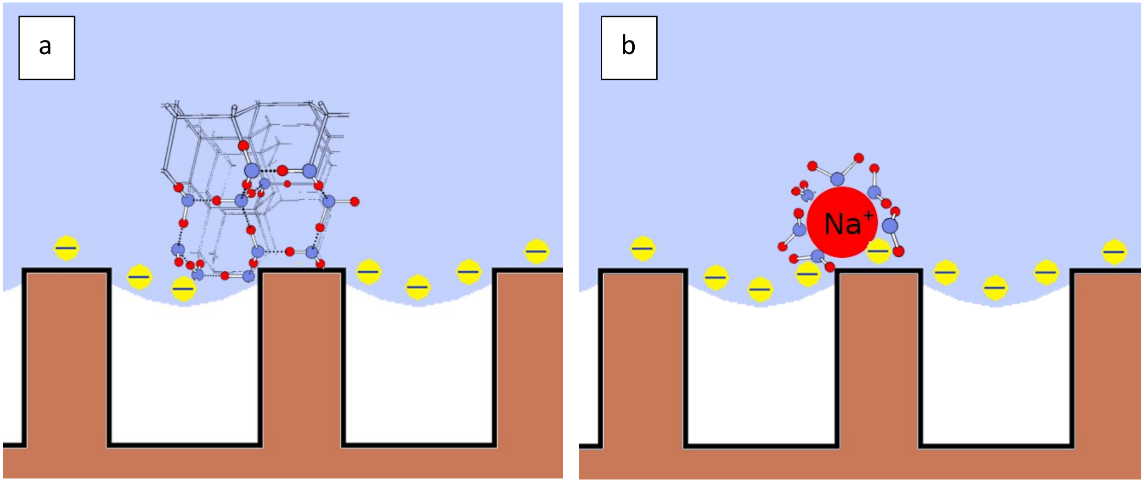

Figure S3. The schematic structure of water in ice nucleus (a) and in the hydration shell (b).

The binding of water molecules, which surround the sodium ions in Stern part of double electric layer (DEL) and drastic deviation in the mutual arrangements of water molecules in the hydration shell (Figure S1b) from those in ice nucleus (Figure S1a), result in the increase in the energetic barrier for the heterogeneous nucleation. Therefore the probability of water staying in supercooled state, as well as the freezing delay time, increase.