Supplementary Information

Condensation heat transfer enhancement through durable, self-propelling fluorine-free silane-treated anodized surfaces

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Figure S1a shows the electropolishing process, where the aluminum substrate is the anode and another aluminum plate of the same size is the cathode, placed parallel to the substrate at a distance of 15 mm. This process is performed in 7 minutes with applied voltage of 24 V and an electrolyte temperature of 0 °C.[1] Figure S1b shows the anodizing process, with the electropolished aluminum substrate as the anode and a steel plate of the same size as the cathode, placed parallel to each other at a distance of 25 mm. This process is performed in 3 minutes with the applied voltage of 130 V and an electrolyte temperature of 50 °C.[1]

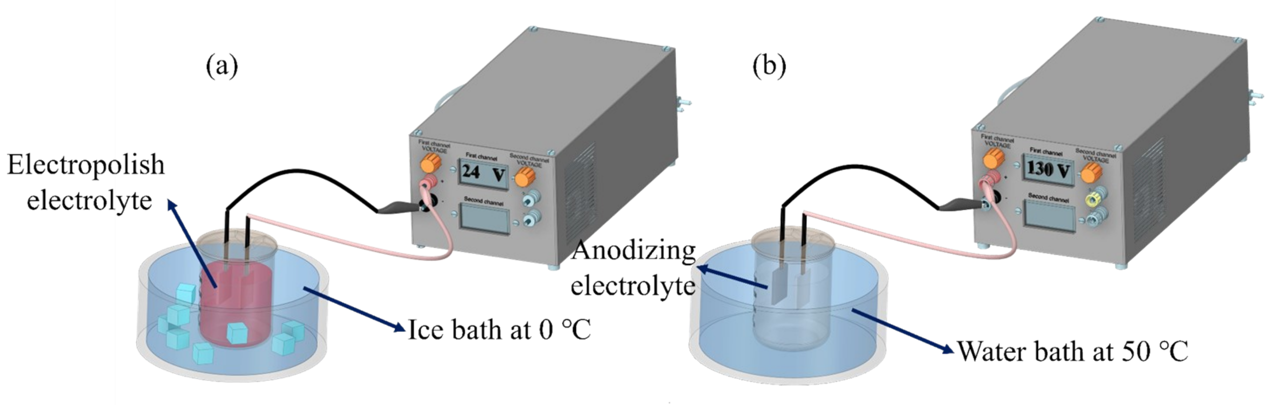

Figure S1. Schematics of (a) Electropolishing process that makes the aluminum surface smooth and (b) Anodizing process that leads to suitable nanostructure on the surface.

Figure S2 illustrates the schematics of the abrasion test, performed by dragging the sample attached to a 100 g weight over a #1000 sandpaper. [2,3] In each cycle of this test, the sample was pulled across a 100 mm distance on the sandpaper.

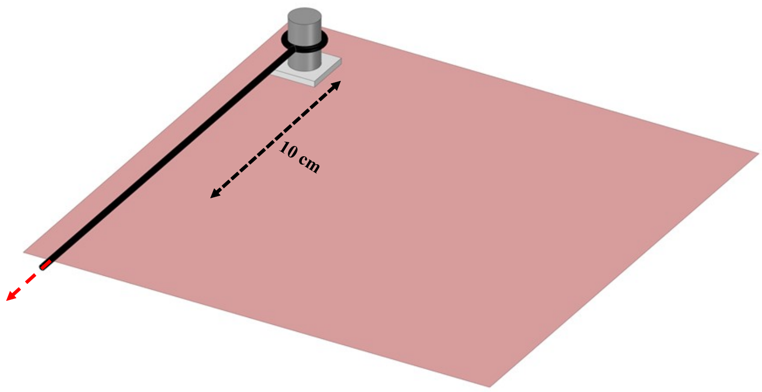

Figure S2. Schematics of the abrasion test encompassing a 100 g weight attached to the back of the coated surface pulled across a #1000 sandpaper.

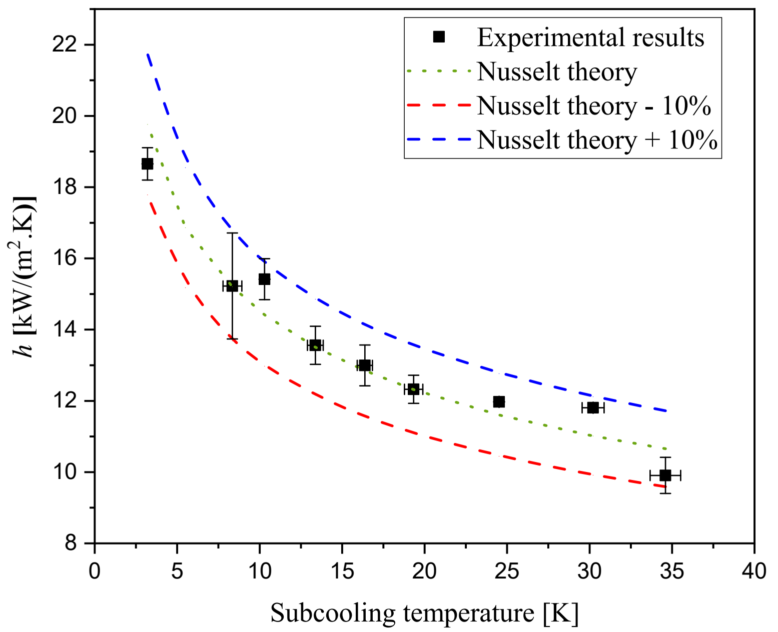

Figure S3. Validation of the apparatus by comparing the heat transfer coefficient of the pristine aluminum surface with the results of the Nusselt theory. The error bars are the results of 3 repetitions of the test.

Nusselt theory is used for the validation process. Accordingly, Figure S3 compares the condensation heat transfer coefficient results of the pristine aluminum sample with the condensation heat transfer coefficient obtained from the Nusselt theory. Due to the theoretical considerations and simplifications of the Nusselt theory, achieving a deviation of less than 10% from the Nusselt theory results is considered valid, verifying our results.[4]

References

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