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Supplementary Material

Superhydrophobic manhole for drops

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Material Treatment for Superhydrophobicity

Copper coupons taken from the same stock material were treated using the procedure described in the main text. The immersion time into the solution comprising 2M NaOH and 1.5 M $(NH_4)2S_2O_8$, however, for each was varied. The SEM micrographs recorded corresponding to this are shown in Figure A. It is clear that with increasing immersion, the structure alters from needle-like at 5 mins, to grain-like at 30 mins, to fluff-like at 120 mins.

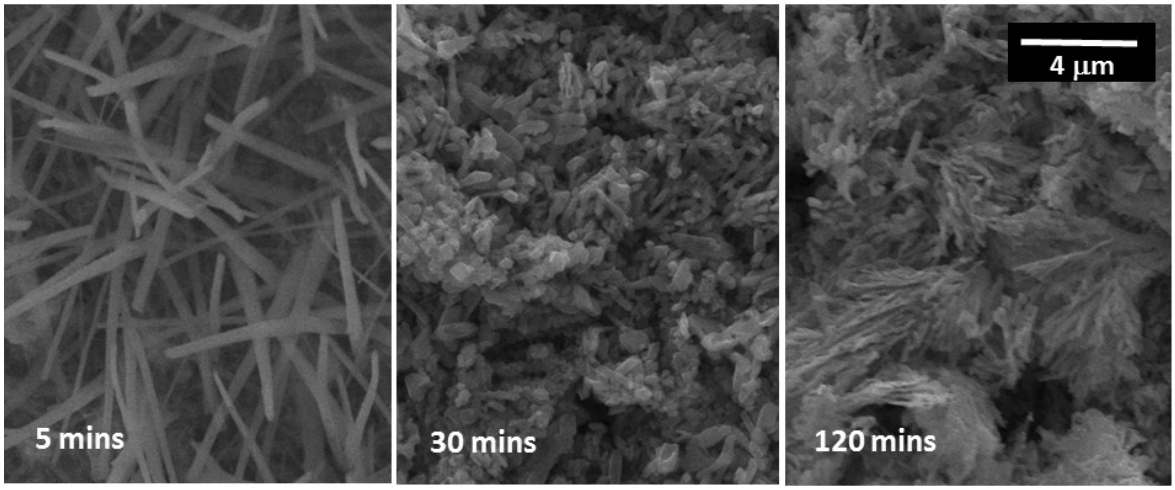

Figure A – SEM micrographs obtained of the copper surfaces treated with different immersion times into the etchant solution.

The wetting characteristics of each of the surfaces after superhydrophobic functionalization with FAS was evaluated by measuring the contact angle of sessile drops deposited. Two liquid types were used; distilled water, and brine, both with trace amounts of silver nanoparticles. The latter was prepared by dissolving 35 g of NaCl (Sigma Aldrich, 310166) in distilled water in order to mimic the typical salt content in seawater. The results are tabulated in Table A. It can be seen that the different structures, related to different immersion times, did not cause significant changes to the superhydrophobic wetting behaviour.

Immersion time (min)	Contact angle (°) with distilled water	Contact angle (°) with brine
5	163.3	167.9
30	164.4	161.5
60	163.7	162.7
120	161.6	162.7

Table A – Tabulation of contact angles found using the sessile drop measurement method in distilled water and brine.

The elemental composition of the fine copper woven mesh surface after functionalization with FAS for superhydrophobicity was verified using energy dispersive x-ray spectroscopy (EDX). In the example trace subjected to 5 keV irradiation shown in Figure B, the peaks for elements C, F, and Si can be attributed to the presence of FAS, consistent with its chemical composition of $C_{16}H_{19}F_{17}O_3Si$. The lack of a peak for H is due to the known difficulty of EDX to reveal the presence of elements that have small atomic numbers. The high peak for Cu is due to the parent copper used. The high content of O can be attributed to having come from the FAS as well as the formation of copper oxides. The latter is inevitable due to atmospheric oxidation of the copper base. The trace also provided some level of confidence that no detectable contaminants were introduced during chemical processing into the material.

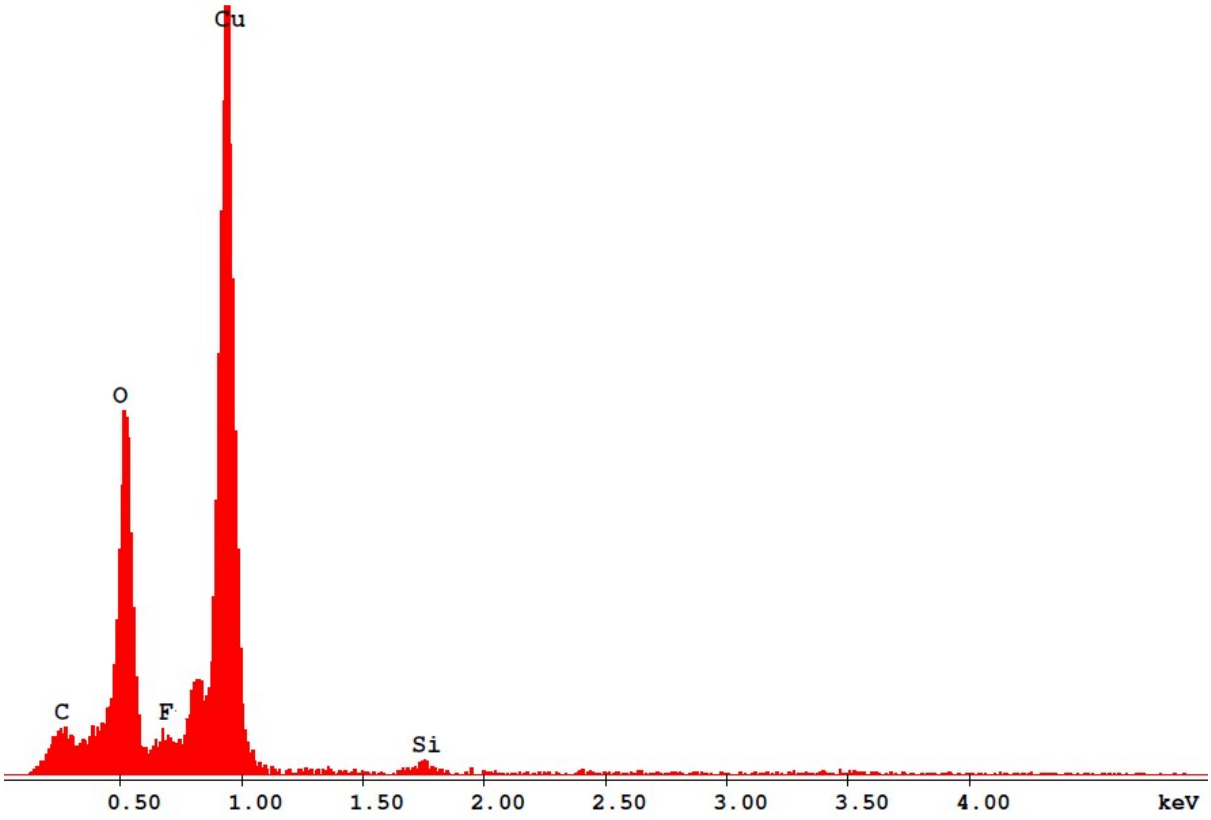

Figure B – Sample EDX trace taken of the fine mesh copper surface after superhydrophobic functionalization.