

Self-healing superamphiphobicity

Xiaolong Wang, Xinjie Liu, Feng Zhou,* Weimin Liu

Experimental. An aluminum foil (thickness 0.25 mm, 99.99%) was cutted into 2 x 4 cm, polished
5 mechanically, and ultrasonically cleaned with acetone and ethanol in sequence to get rid of grease. The
pre-cleaned Al foil was electrochemically etched in aqueous solution at 4 V for 3 h at room
temperature to obtain AA1. AA1 was further anodized at a high constant current density of 325
mA•cm⁻² in 0.3 M oxalic acid for 5 min at 10 °C to obtain nanoporousd alumina (AA2). The AA2 was
then immersed into perfluorooctyl acid (PFA) in a vessel at 65 °C under vacuum for 20 min to load
10 PFA into the nanopores. After cooling, the treated AA2 was rinsed twice with acetone to remove the
unloaded PFA and dried with nitrogen flows to obtain PFA loaded AA2 (PFA-AA2). According to the
pore dimensions, the maximal PFA loaded into AA2 is 32 mg/cm² AA2.

Plasma treatment: The oxygen plasma treatment was used to facilitate failure of
superamphiphobicity, which was carried out by an oxygen plasma instrument (Diener electronic,
15 German). The PFA-AA2 was treated for 30 seconds with power of 98W.

Characterization: The surface nanostructures were observed using a field-emission scanning
electron microscope (SEM, JSM-6701F, Japan) at 5-10 kV. Chemical composition information were
obtained by X-ray photoelectron spectroscopy (XPS), which was carried out on a PHI-5702 multi-
functional spectrometer using Al K α radiation and the binding energies were referenced to the C1s line
20 at 284.8 eV from adventitious carbon. Sessile contact angles (CA) were acquired using a DSA-100
optical contact-angle meter (Kruss Company, Ltd, Germany) at ambient temperature (25 °C) by
injecting 5 μ L of testing liquids onto the samples, and the CA value was determined automatically
using the Laplace–Young fitting algorithm. Average CA values were obtained by measuring the
sample at five different positions, and images were captured with a digital camera (Sony, Ltd, Japan).

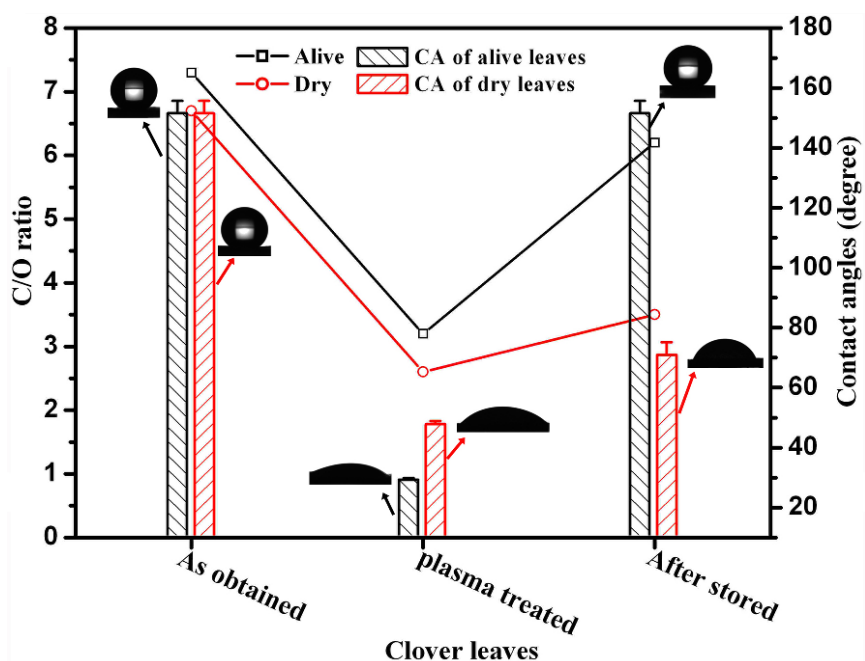


Fig. 1. Changes of C/O ratio (lines) and CAs (bars) of clover leaf surface.

Table 2. Surface chemical composition of PFA modified AA1 and AA2

Samples	Atomic concentration (%)		
	C	O	F
PFA-AA2	26.88	23.25	43.51
Plasma treated PFA-AA2	27.81	30.48	31.54
Plasma treated PFA-AA2 with 72h-healing	24.14	25.20	36.80
PFA-AA2 with 6 failure and healing cycles	28.81	34.05	25.17
PFA-AA2 with 8 failure and healing cycles	35.37	36.32	16.63
PFA-AA1	38.23	25.96	30.00
Plasma treated PFA-AA1	33.66	40.19	12.39
Plasma treated PFA-AA1 after stored for 72h	29.39	37.24	14.74