

## Supplementary Material for

# Highly Rough Surface Coatings *via* the Ambient Temperature Deposition of Thermosetting Polymers

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## Materials and Methods

### Materials

SYLGARD® 184 Silicone Elastomer was purchased from Dow Chemical. This elastomer consists of two parts: the polymer, polydimethylsiloxane (PDMS), and a curing agent, which is silicon based. Chloroform was purchased from Fisher scientific. In the main part of this work the glass microscope slides from Thermoscientific were used as the substrates. Subsequent experiments were conducted on temperature-sensitive substrate, this included; paper, cardboard, aluminium (all acquired from RS Components).

### Solution preparation

Both polymer parts, with a ratio (10:1), were dissolved in chloroform (0.7 g of polymer in 100 ml). The mixture was allowed to stir for 15 minutes which allowed the polymer to fully dissolve. The prepared solution was used immediately after stirring was stopped.

### Pre-treatment of Glass Substrates

To increase the adhesion, glass substrates were pre-coated with a thin layer of flat PDMS. Typically, both polymer parts were used with the previous ratio, with 2.0 g of polymer were dissolved in 10 ml of chloroform. After stirring for 10 minutes, a portion of the solution were used to nearly cover a microscope slide. Spin-coating were used to cast a thin layer of the polymer solution. A speed of 4000 rpm were applied for 25 seconds. The coated glass were subjected to a heat for ~1 minute using a heat gun.

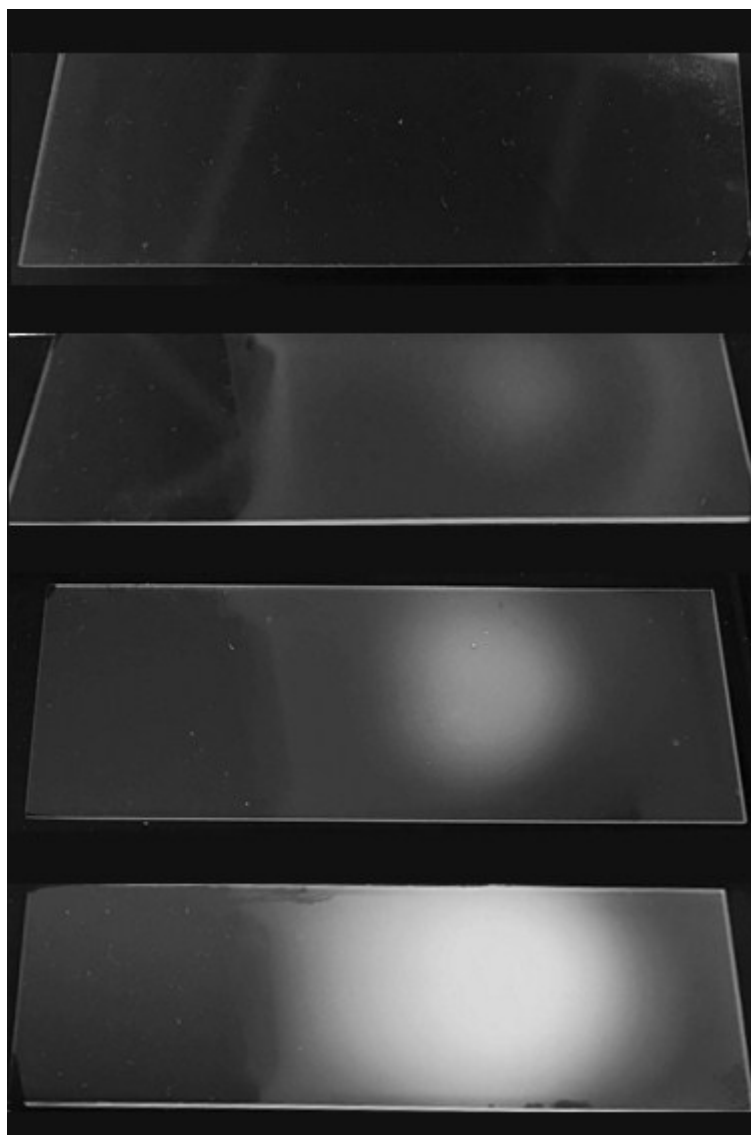
### Deposition Conditions

The deposition was carried out in a setup similar to the schematic in **Figure 1** (main manuscript). An ultrasonic humidifier was used to generate the aerosol from the prepared solution. This aerosol was then carried by a flow of nitrogen gas and allowed to cure in a tube

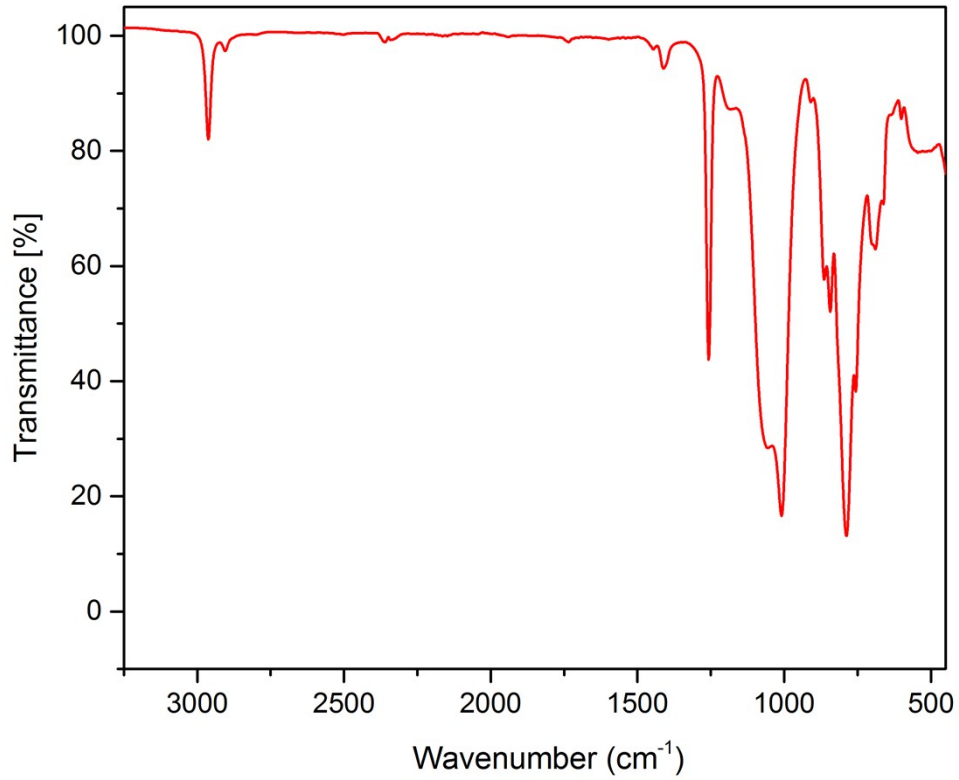
furnace, were the activation temperature (temperature inside the tube furnace) was varied from 200-400°C. The substrate was placed outside the furnace, 1 cm from the furnace outlet. The polymer flow moves through the outlet and impacts the substrate where it is deposited. The carrier gas flow was adjusted to 1.0 L/min. The deposition process continued for approximately 60 minutes. The deposition temperature (the temperature at the substrate) was measured by placing a thermometer at the substrate position while the deposition took place.

### Characterization

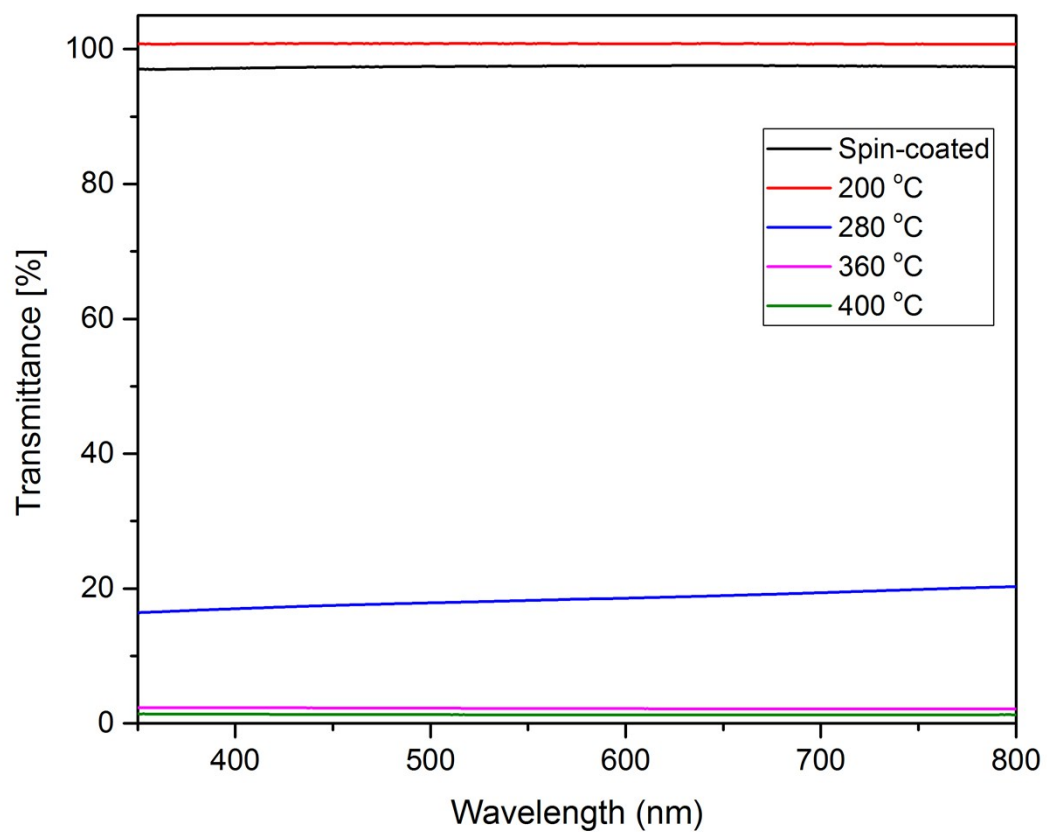
IR spectrum was obtained using Bruker (Vertex 70) FT-IR. Light-interaction with samples, as an indication for the surface roughness, were examined by measuring visible-light transmission through the prepared surfaces (a smooth surface prepared by spin-coating and surfaces prepared using AACVD at different curing temperatures), using Agilent Technologies (Cary 5000) UV-vis-NIR spectrometer (over a wavelength range of 350-800 nm). Kruss (DSA100E) Drop Shape Analyser was used to measure WCAs, using a water droplet volume of 5 µL. This was repeated five times for each sample and the average was calculated. Water droplets were dropped from a height of 20 mm (tip to surface) using a microsyringe fitted with a 27 gauge dispensing tip (unless otherwise stated). The water droplets from this tip were 8 µL in size and were left to detach under their own weight. Methylene blue was added to the water to aid visualisation, this was not observed to change the behaviour of the water droplets on the surface. The bouncing was filmed at 1000 frames per second using a SONY RX10-III camera. Scanning electron microscopy (SEM) images were performed using a field emission microscope (JEOL, JSM-7001F) using an acceleration voltage of 10 kV for samples deposited on glass substrates, and 5 kV for the remaining samples. Materials robustness testing was carried out using the application/removal of adhesive tape (Scotch Tape - 600), whereby a portion of tape was applied to the coating, secured by manually pressing down, and then arbitrarily removed from the surface. A scalpel blade was also used to assess resilience, using a range of pressures to scrap the surface coating.



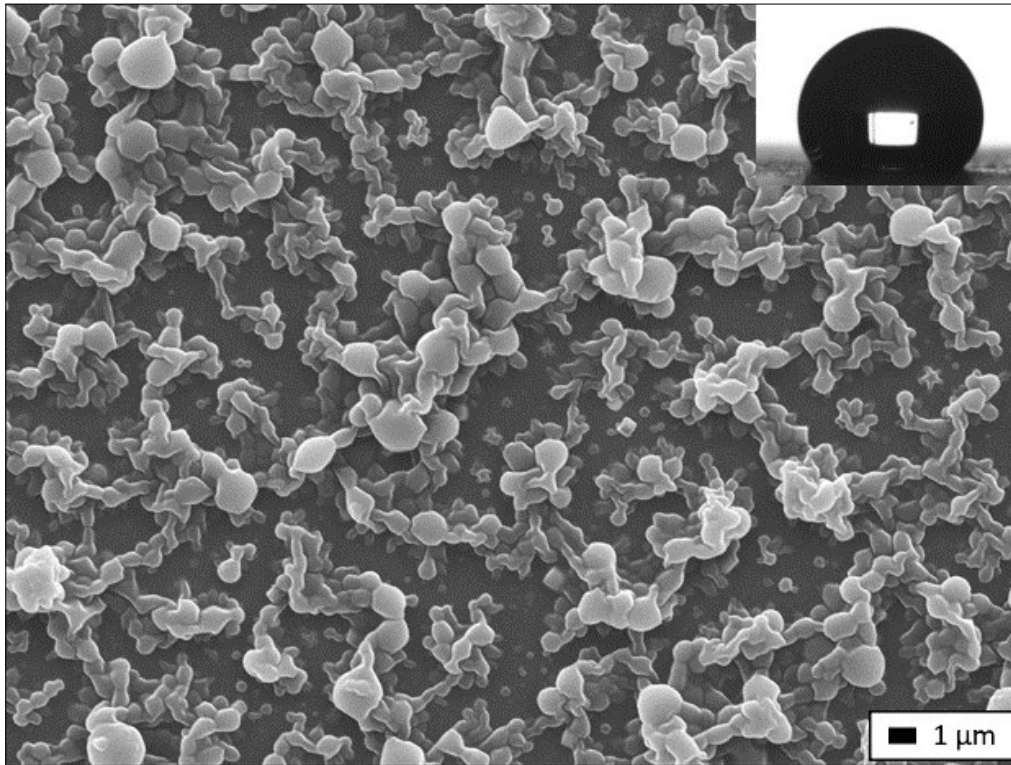
**Figure S1:** PDMS coating on glass substrates using ta-AACVD at (from top to bottom) 200, 280, 360 and 400 °C. The difference in light-interaction behaviour between them is noticeable, although the amount of deposited PDMS on all of them is approximately the same. Transmittance UV-vis spectra of each is provided in Figure S3. The substrates are typical glass microscope slides, with dimensions of (76mmx26mm).



**Figure S2:** FT-IR graph of PDMS scratched from a coated glass slide, confirming polymer deposition. The main peaks (Si-CH<sub>3</sub> stretching and bending peaks at 780 and 1257 cm<sup>-1</sup>, Si-O-Si at 1000 cm<sup>-1</sup> and C-H stretching at 2962 cm<sup>-1</sup>) could be identified in the graph. The spectra is unchanged from the FT-IR spectra of PDMS cured at room temperature.



**Figure S3:** Transmittance curve of visible light region (from 800 to 350 nm) through five PDMS samples: spin-coated on glass, prepared using ta-AACVD at temperature of 200, 280, 360 and 400 °C. The graph shows the change of transmittance behaviour, as an indication of changes in surface structure.



**Figure S4:** SEM images of SYLGARD® 184 Silicone Elastomer applied to glass substrates using AACVD at a temperature of 450°C. It is noticed the amount of polymer is less in this sample compared to samples done at lower temperatures, suggesting that high temperatures can cause a fast polymer curing, leading to a considerable quantity of the polymer being deposited on the furnace walls. The shape of the polymer also indicates polymer degradation started at such high temperature. A photograph used to measure the contact angle of a water droplet placed on these surface is shown in the upper left, where lower contact angle could be noticed (124.6° on average).