Electronic Supplementary Material (ESI) for Analyst.

Supporting Information

Sample stage designed for force modulation microscopy using a tip-mounted AFM scanner

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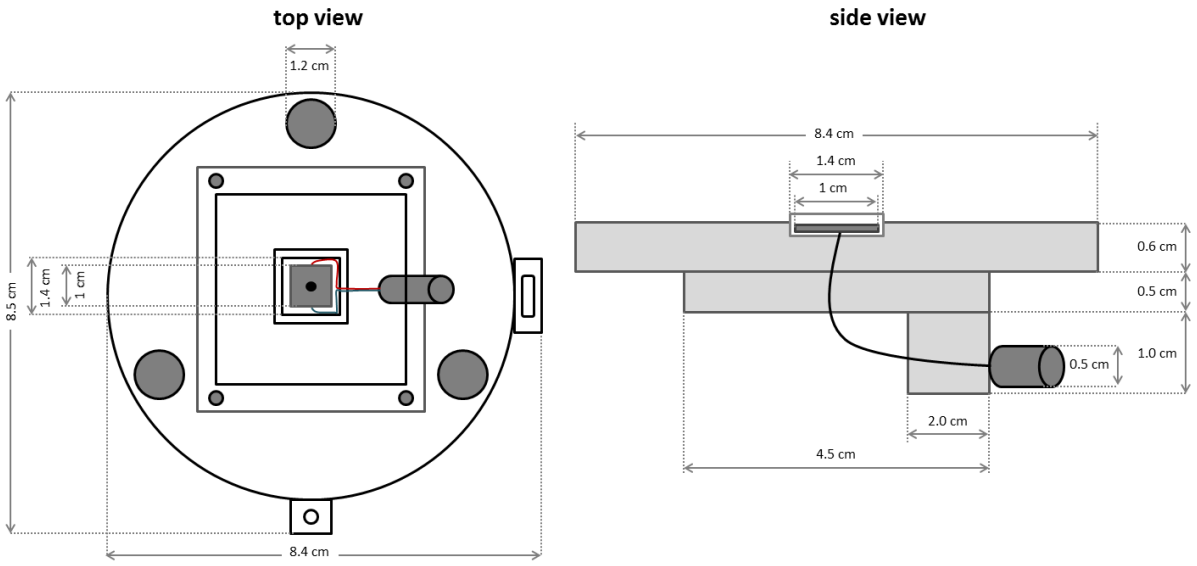

Fig. S1. Physical dimensions of the force modulation sample stage. At the center of the stage, a square (1×1 cm^2) piezoactuator is located underneath a polycarbonate plate (1.4×1.4 cm^2). There is a small air gap surrounding and between the polycarbonate pieces and the sample stage so that only the central area is driven to vibrate.

Fig. S2 Nanopores within a thin film of OTS prepared by particle lithography combined with solution immersion.[1] A drop of an aqueous suspension of silica mesospheres in water (10 μL) was deposited on a clean Si(111) substrate. The sample was dried in air for 2 h to produce surface masks. As water evaporated during the drying step, capillary forces pull the mesospheres together to form crystalline layers on flat surfaces. The substrate was placed in an oven at 140 C overnight to temporarily anneal the mesospheres to the surface. After cooling, the sample was immersed in a 0.1% solution (v/v) of OTS in toluene for 5 h to form an OTS film surrounding the surface mask. To remove the mesoparticles, the substrate was sonicated for 15 min in ethanol and water successively. The sample was dried under argon before characterization with FMM-AFM.

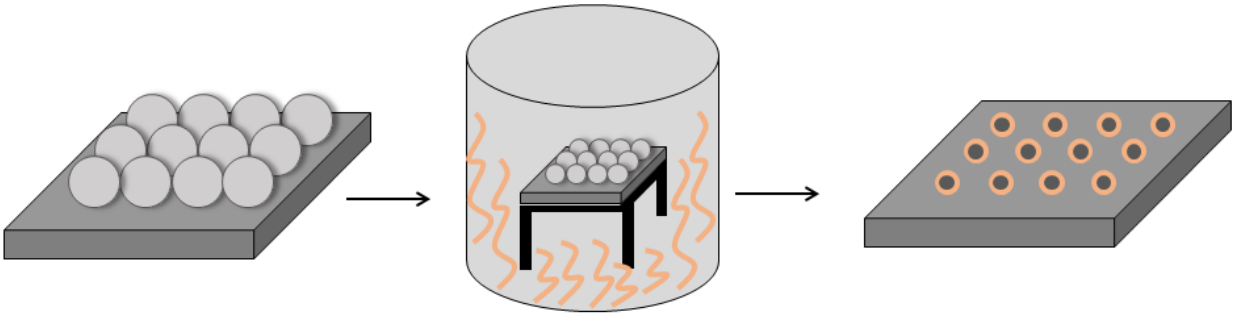

Fig. S3 Nanorings of PEG-silane prepared using particle lithography combined with heated vapor deposition.[2] A drop of a suspension of 500 nm latex mesospheres (10 μL) in water was deposited on a clean Si(111) substrate. The sample was dried in air for 5 h to produce surface masks. Next, the sample was placed in a vessel containing 300 μL neat PEG-silane. The sealed container was placed in an oven (70 C) overnight. Vapor-phase PEG-silane will attach to the Si substrate except in places where the mesosphere mask has protected the substrate. After cooling, the sample was rinsed with water and ethanol. To remove the mesoparticles, the substrate was sonicated for 15 min in ethanol, toluene, and water successively. The sample was dried under argon before characterization with FMM-AFM.

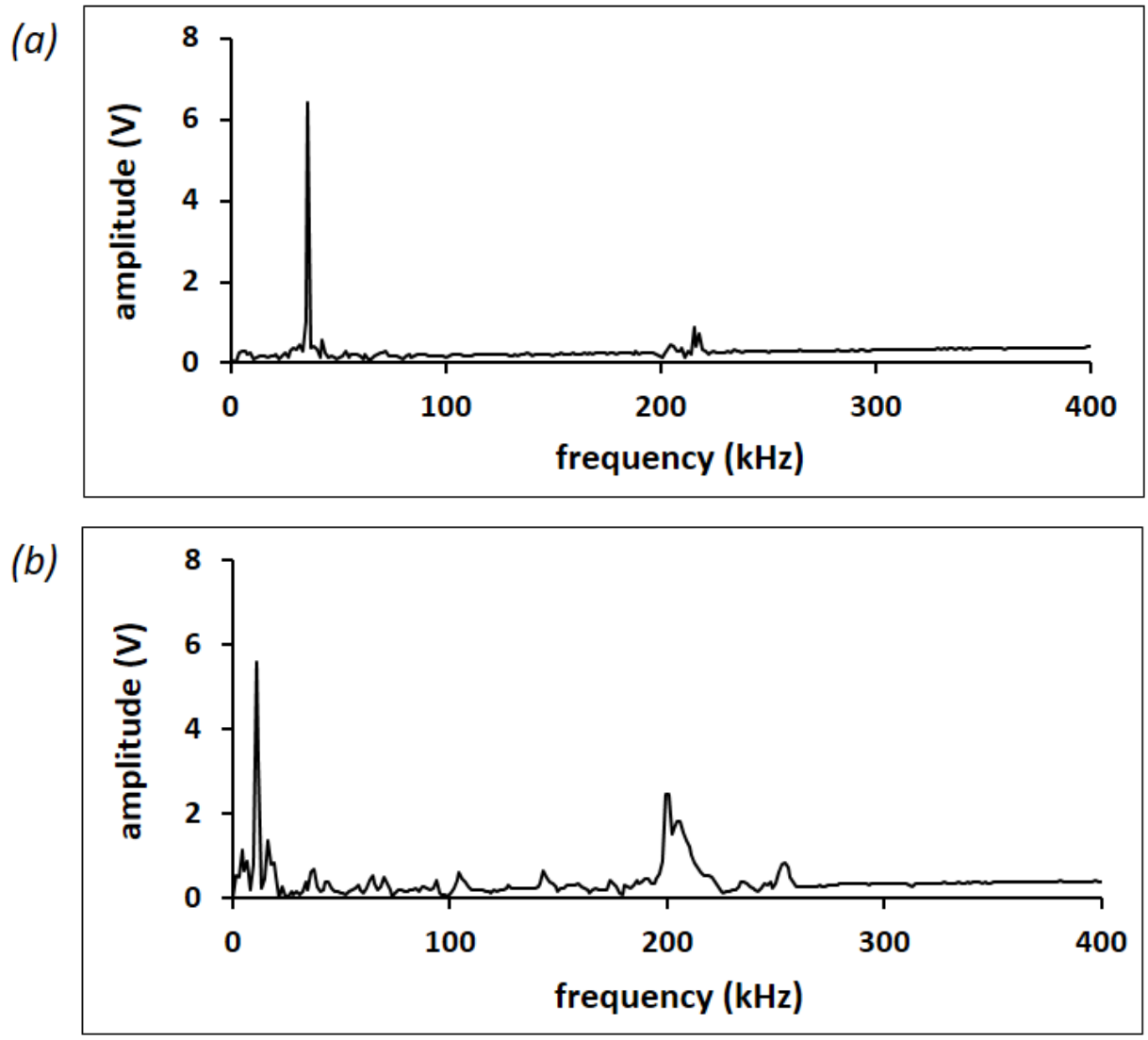

Fig. S4 Comparison of frequency sweeps before (a) and after (b) the tip is engaged with the sample.

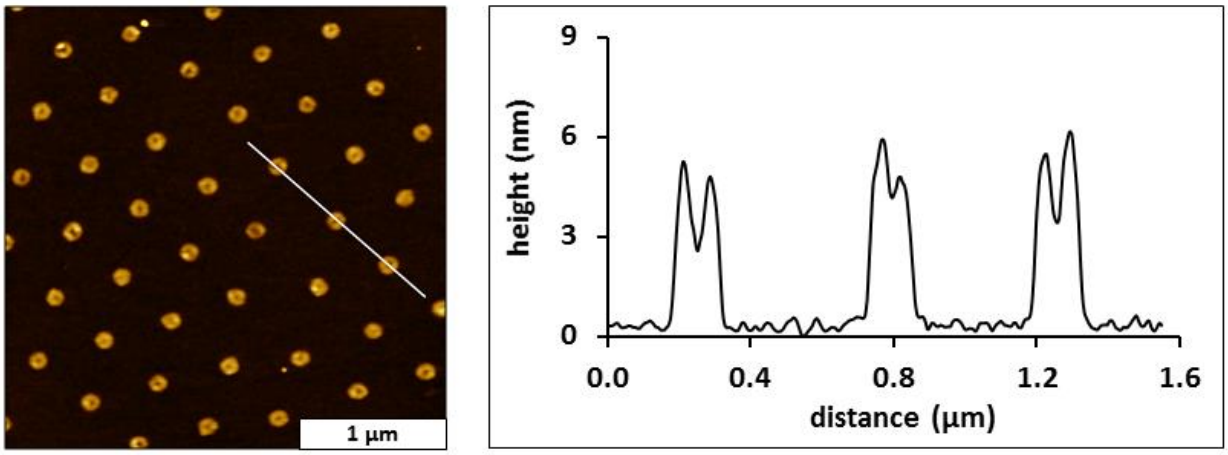

Fig. S5 Height measurements of nanorings of PEG-silane. (Left) View of PEG-silane nanorings revealed with a topography frame; (Right) Height profile for the white line drawn across three nanorings. The centers of the nanorings reveal uncovered silicon substrate. Molecules can be backfilled into the center of the nanoring, which is reported in previous studies.[1,2] In this example, the AFM tip does not penetrate all the way to the substrate in the cursor profile because the probe is larger than the nanostructures.

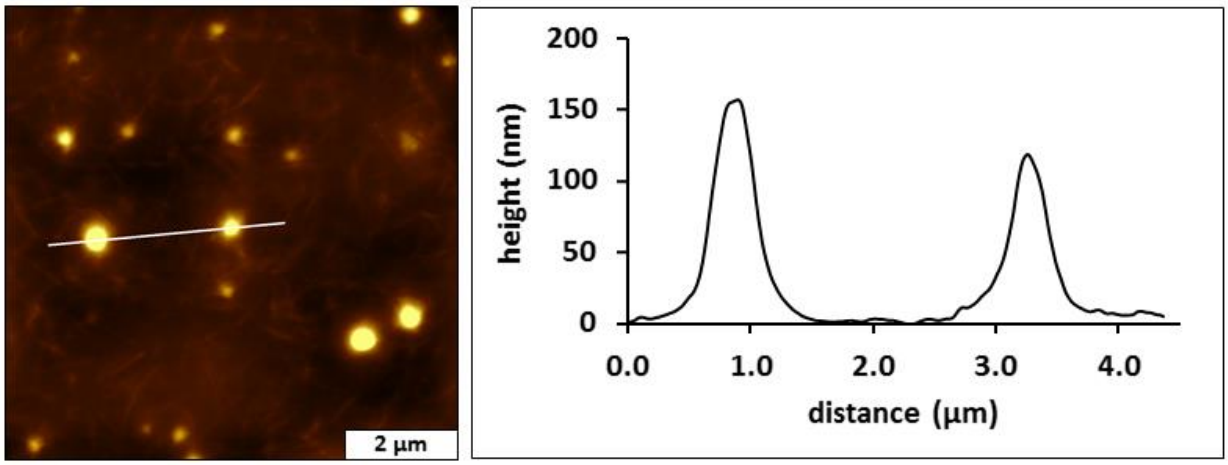

Fig. S6 Height measurements of selected aggregates of the polymer gel. (Left) View of the polymer gel sample disclosed with a topography frame; (Right) Height profile for the white line drawn across an area of the nanoclusters.

References

1. Saner, C. K.; Lusker, K. L.; LeJeune, Z. M.; Serem, W. K.; Garno, J. C., Self-assembly of octadecyltrichlorosilane: Surface structures formed using different protocols of particle lithography. *Beilstein Journal of Nanotechnology* **2012,** *3*, 114-122.
2. Li, J.-R.; Garno, J. C., Elucidating the role of surface hydrolysis in preparing organosilane nanostructures via particle lithography. *Nano Letters* **2008,** *8* (7), 1916-1922.