The adhesion of mussel foot protein-3 to TiO_2 surfaces: the effect of pH

Jing Yu[1*], Wei Wei[2*], Matthew S. Menyo[3], Admir Masic[4], J. Herbert Waite[2,5] and Jacob N. Israelachvili[1,2];

[1]Chemical Engineering, University of California, Santa Barbara, California 93106, USA.
[2]Materials Research Laboratory, University of California, Santa Barbara, California 93106, USA.
[3]Biomolecular Science and Engineering, University of California, Santa Barbara, California 93106, USA
[4]Department of Biomaterials, Max Planck Institute for Colloids and Interfaces, 14424 Potsdam-Golm, Germany
[5]Department of Molecular, Cell & Developmental Biology, University of California, Santa Barbara, California 93106, USA.

Supporting information

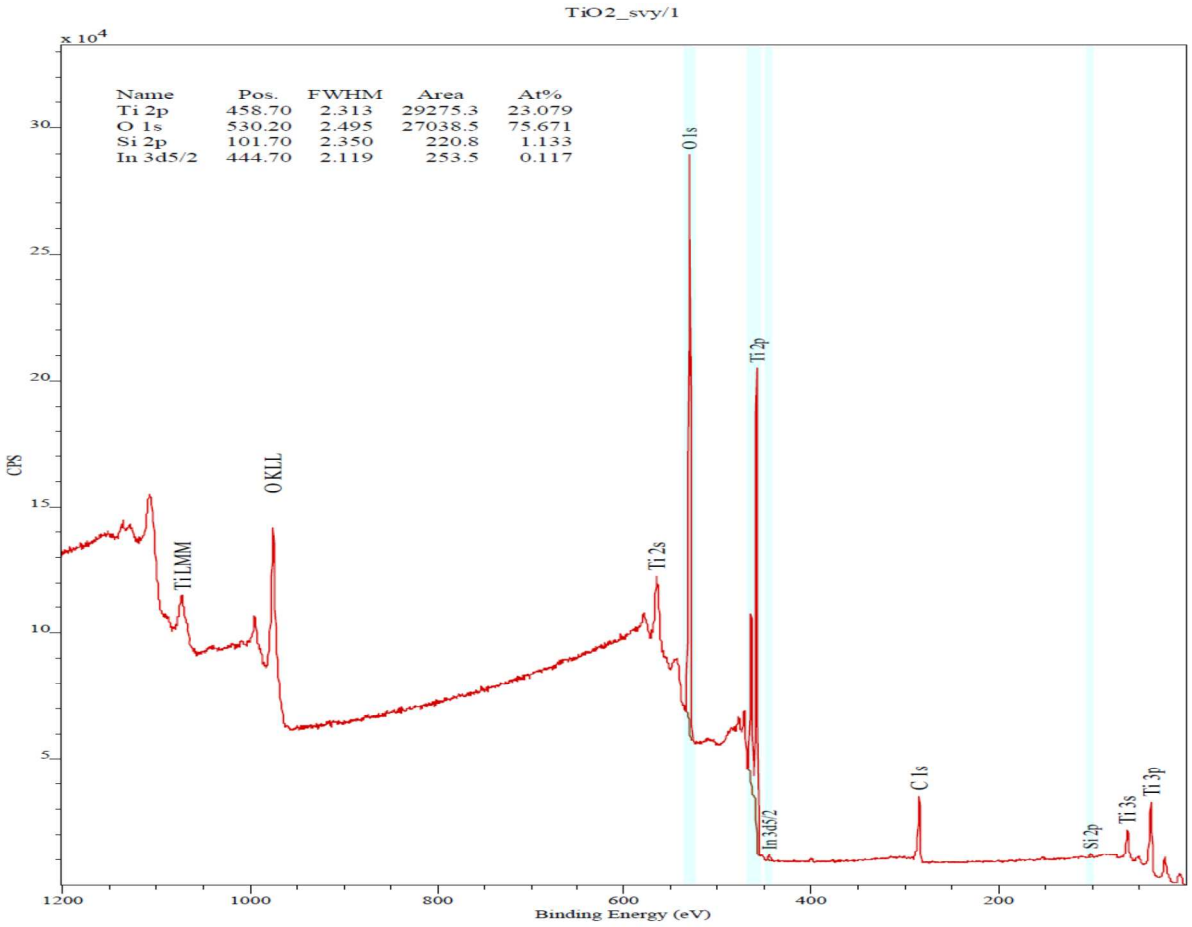

Figure S1. XPS spectra of a TiO_2 layer (10 nm thick) deposited on a mica surface.

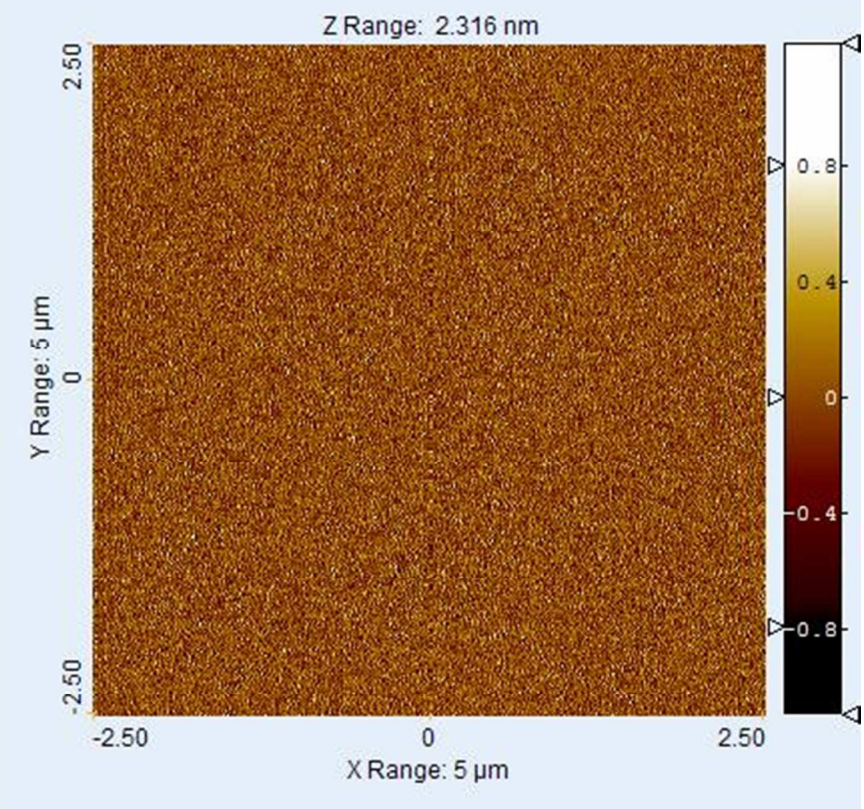

Figure S2. Tapping model image (5 µm × 5 µm) of the surface profile of a 10 nm thick TiO_2 layer deposited on a molecularly smooth mica substrate. The RMS roughness of the TiO_2 surface is ~ 1nm. The RMS roughness of mica is 0.1 nm.

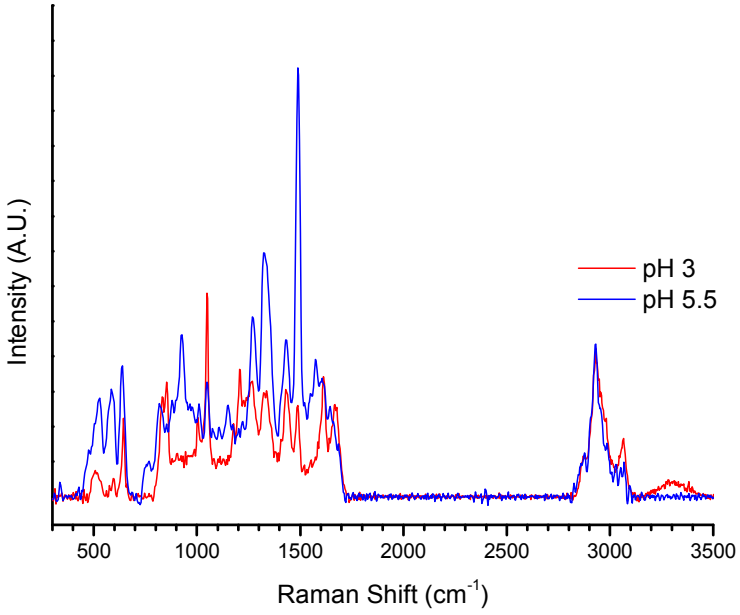

Figure S3. Complete Raman spectra showing normalization to C-H region from 2800-3000 cm^{-1}.

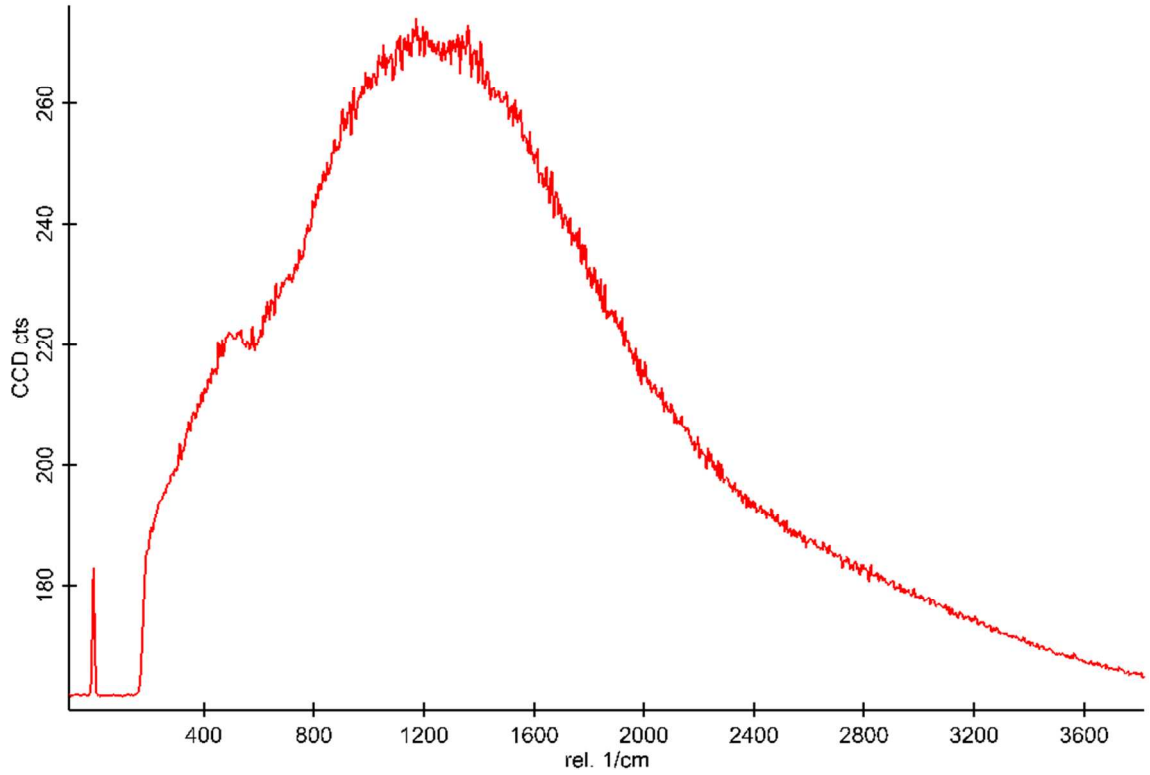

Figure S4. Very strong fluorescence was observed for at the pH=7.5, indicating possible oxidation processes.

Calculation of the binding energy of Dopa to TiO_2

Mfp-3 adsorption was done by putting a droplet of 10-15 µL mfp-3 solution (Conc. 5 µg/ml) one TiO_2 surface. The proteins were allowed to adsorb for 20 min followed by rinsing thoroughly with buffer. Assuming full adsorption of mfp-3 gives 1.07×10^{-11} mole of mfp-3 adsorbed on the TiO_2 surface with a Dopa density of 5.4×10^{-7} /m^2. The strongest adhesion energy measured by SFA is about 6.6 mJ/m^2. Although the actual adsorption efficiency of Dopa to each mica surface is unknown, the maximum possible would be 50% - half on each of two surfaces. This provides a lower energy estimation for the Dopa-TiO_2 interaction and leads to a Dopa- TiO_2 binding energy of ~ 12 kJ/mol or 4.9 k_BT per bond (T = 298K), which is an order of magnitude larger than the Dopa-mica binding energy (~ 0.9 kJ/mol).