

Supporting Information for :

Large-scale nanopatterning of single proteins used as carriers of magnetic nanoparticles

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Tip-based local oxidation: The experiments were performed with a dynamic atomic force microscope operated in the low amplitude solution (non-contact) and with additional circuits to apply voltage pulses. Noncontact AFM nanolithography was performed with doped n^+ -type silicon cantilevers (Nanosensors, Germany). The force constant k and resonance frequency f_0 were about 35 N m^{-1} and 320 kHz , respectively. The cantilever was excited at its resonance frequency.

Stamp fabrication: Polydimethylsiloxane (PDMS) stamps were fabricated by using a DVD master. The master was placed in a clean Petri dish (12 cm in diameter). A mixture of 60 g Sylgard-184 silicone elastomer and 6 g Sylgard-184 silicon elastomer curing agent (Dow Corning) was poured over the master. After 20 min, the Petri dish was placed in a low vacuum chamber for 30 min to remove the gas bubbles. Then, the Petri dish was baked at 90°C for 45 min. The cured PDMS was peeled off the master and then cut to the final stamp size.

Dependence of the ferritin attachment on the surface functionalization and pH

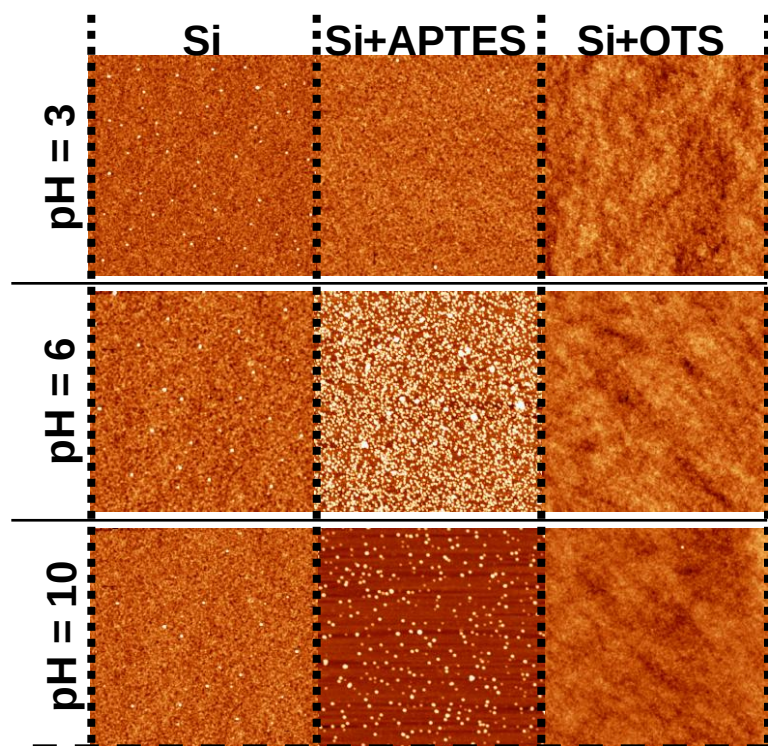


Figure S1. Dependence of the ferritin attachment on the different silicon surface preparation. Each panel has a scan size of $3 \mu\text{m} \times 3 \mu\text{m}$.

Fig. S1 shows some AFM images that illustrate the presence of ferritin proteins on the different surfaces. From images like these we have generated the quantitative data shown in the histograms of Fig. 1.

The ferritin molecules can be removed from the surface by sonication in an aqueous solution of the proper pH. Fig. S2 illustrates (from left to right) a sequential process where the molecules were first deposited on an APTES silicon surface, then removed by sonicating the sample in a solution of pH=3. This process does not alter the properties of the surface because the ferritin molecules were re-attached by depositing them at pH=6 for 45 s. This experiment also illustrates the electrostatic nature of the ferritin-surface interaction.

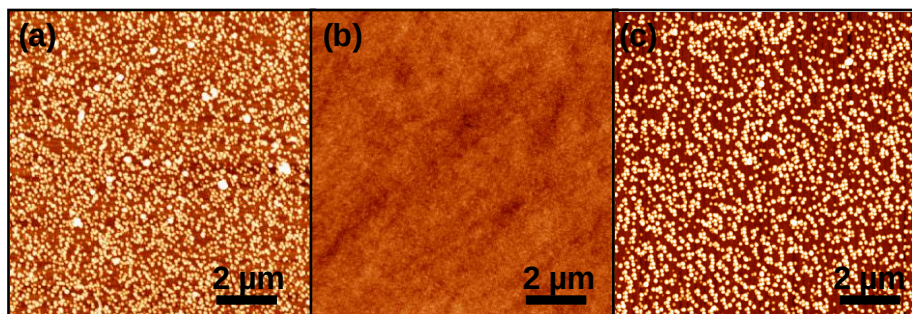


Figure S2. Reversible attachment of the ferritin onto on a APTES functionalized Si surface. a) AFM image of Si+APTES surface after a deposition of ferritin molecules at pH=6. A high density deposited ferritin molecules is observed. b) The molecules are removed after sonicating the surface in an aqueous solution of pH=3 for 10 s. c). AFM image of a region of the same sample surface after redepositing the proteins. The image shows a high density of ferritin molecules. The ability of the Si+APTES surface to attach ferritin has not been altered by the sequence of deposition and cleaning steps.