Supplementary Information for

Immobilization of Detonation Nanodiamonds on Macroscopic Surfaces

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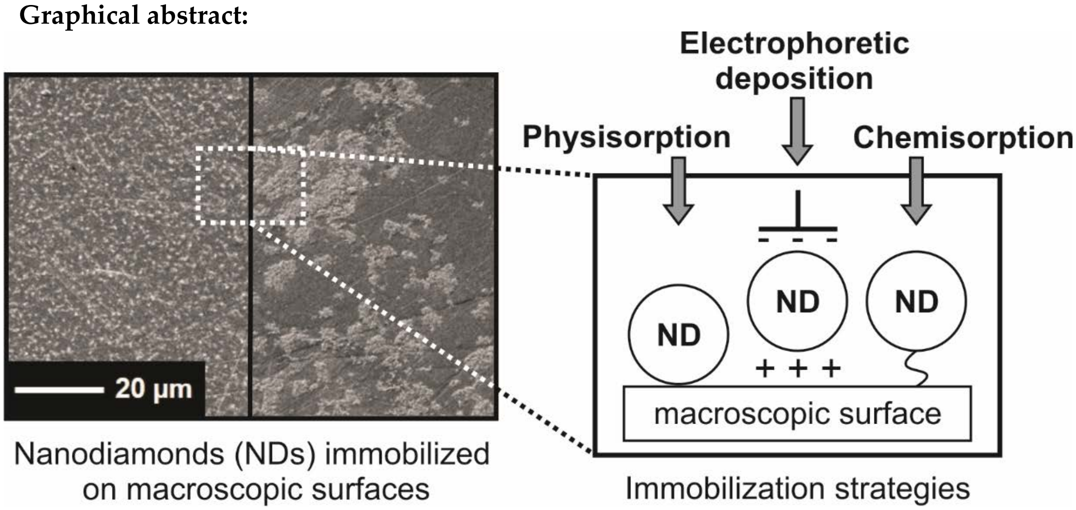
Abstract: Detonation nanodiamonds (NDs) are a novel class of carbon based nanomaterials and have received a great deal of attention in biomedical applications due to their high biocompatibility, facile surface functionalization and commercialized synthetic fabrication. We were able to transfer the NDs from large size agglomerate suspensions to homogenous coatings. ND suspensions were used in various techniques to coat on commercially available substrates of pure Ti and Si. SEM imaging and nanoindentation showed the densest and strongest coating of NDs was generated when using EDC/NHS-mediated coupling to macroscopic silanized surfaces. In the next step the feasibility of DNA-mediated coupling of NDs on macroscopic surfaces is discussed using fluorescent microscopy and additional particle size distribution as well as zeta potential measurements. This work compares different ND coating strategies and describes the straightforward technique of grafting single-stranded DNA onto carboxylated NDs via thioester bridges.

Graphical abstract:



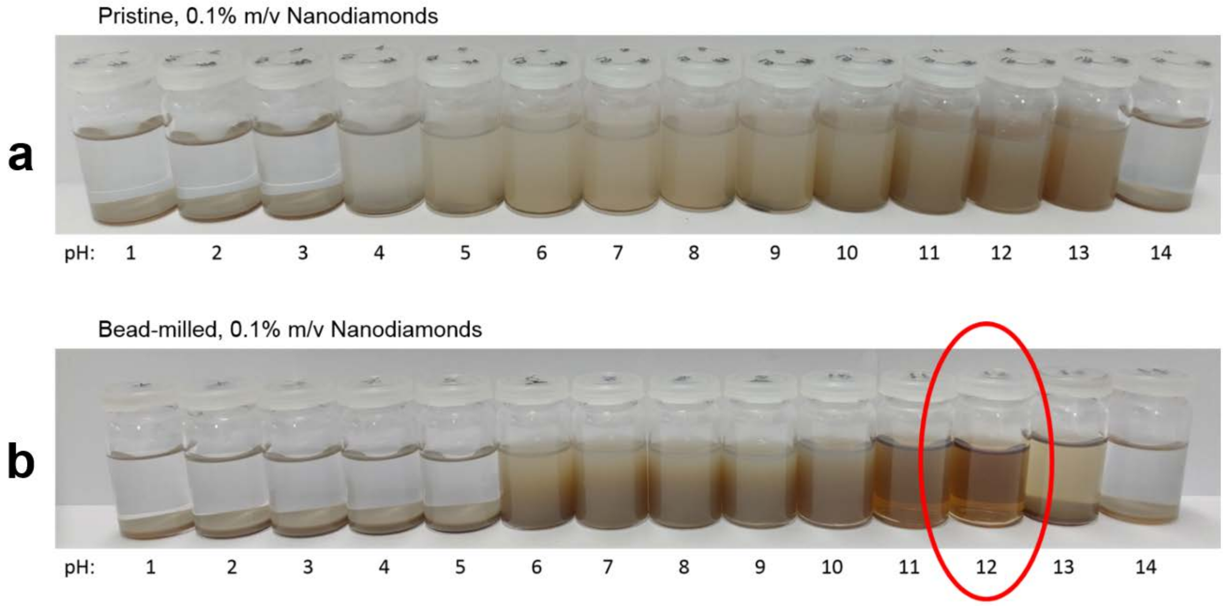


Figure S1. Sedimentations rows of (a) pristine and (b) bead-milled 1 mg/mL aqueous ND suspension at pH ranging from 1 to 14. Red circle marks the 0.1 mg/mL bead-milled ND suspension with agglomerate size 43 nm and zeta potential of -71 mV.

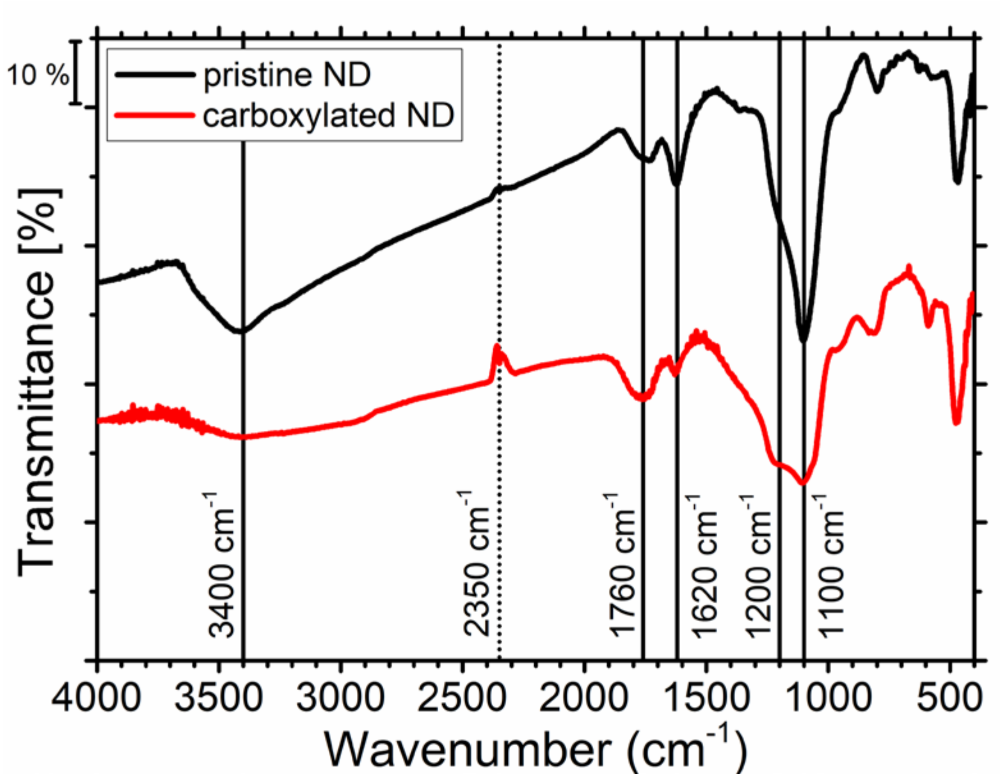


Figure S2. FT-IR measurements of pristine NDs (black) and carboxylated NDs (red). Broad peak from approx. 3200 – 3500 cm^{-1} is caused by OH groups with hydrogen bonds, 1760 cm^{-1} is related to carbonyl C=O groups, 1620 cm^{-1} to C=C groups, 1200 cm^{-1} phenolic C-O groups and 1100 cm^{-1} corresponds to absorption by sp3-CH groups. Peak at 2350 cm^{-1} (dotted line) is related to CO_2 signal due to ambient air.

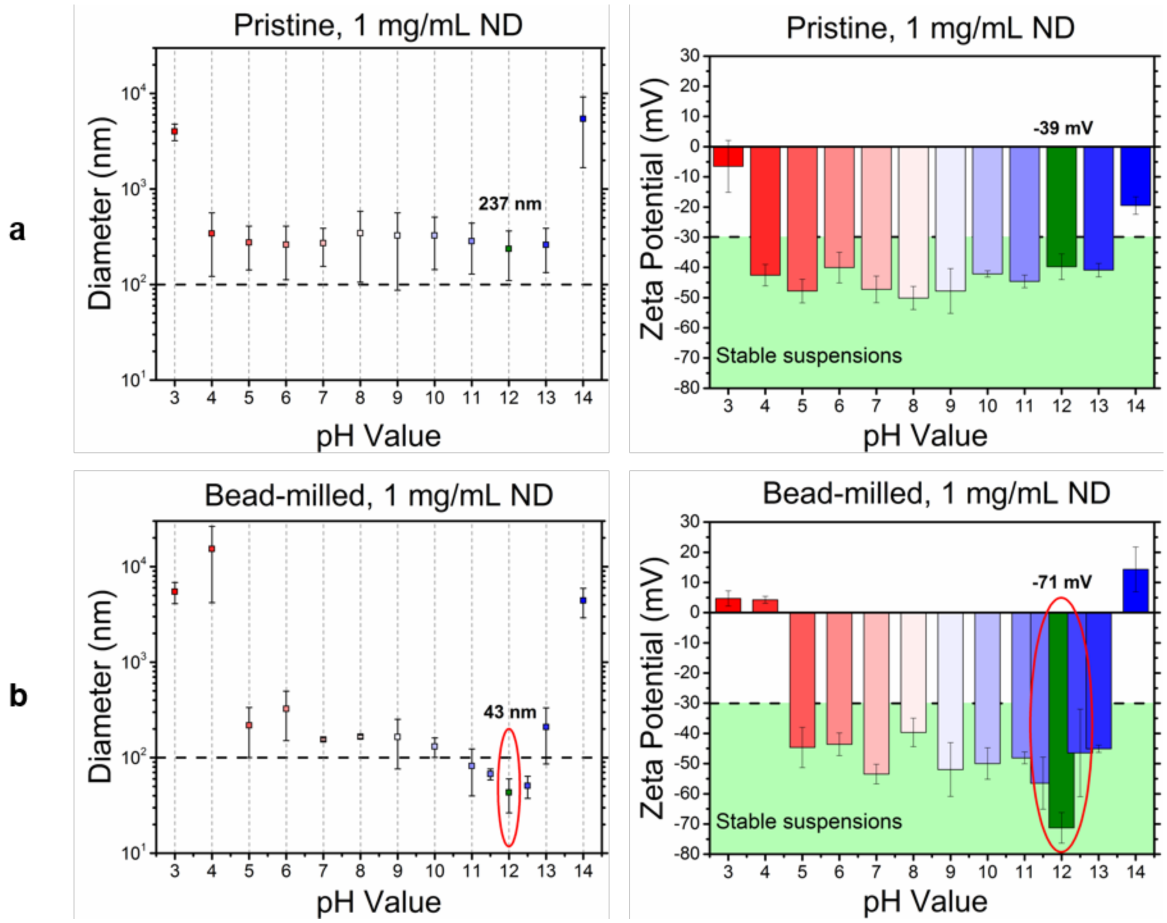


Figure S3. Particle size distribution and zeta potential measurements of (a) pristine and (b) bead-milled 1 mg/mL aqueous ND suspensions under various pH conditions. Initial pH values of pristine and bead-milled ND suspensions ranging from 4 to 5.

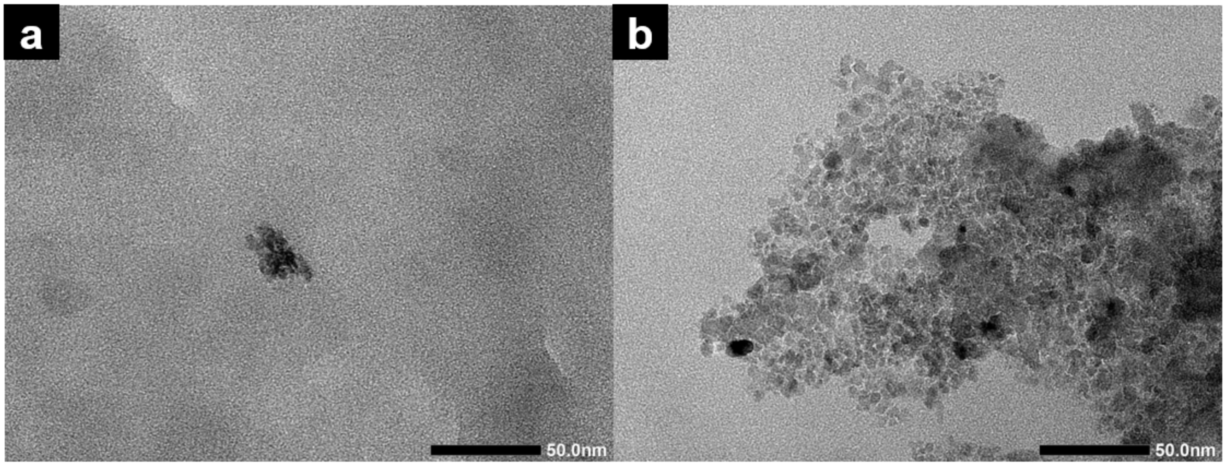


Figure S4. TEM images of (a) single ND agglomerate and (b) ND agglomerate cluster of bead-milled 1 mg/mL aqueous ND suspension at pH=12.

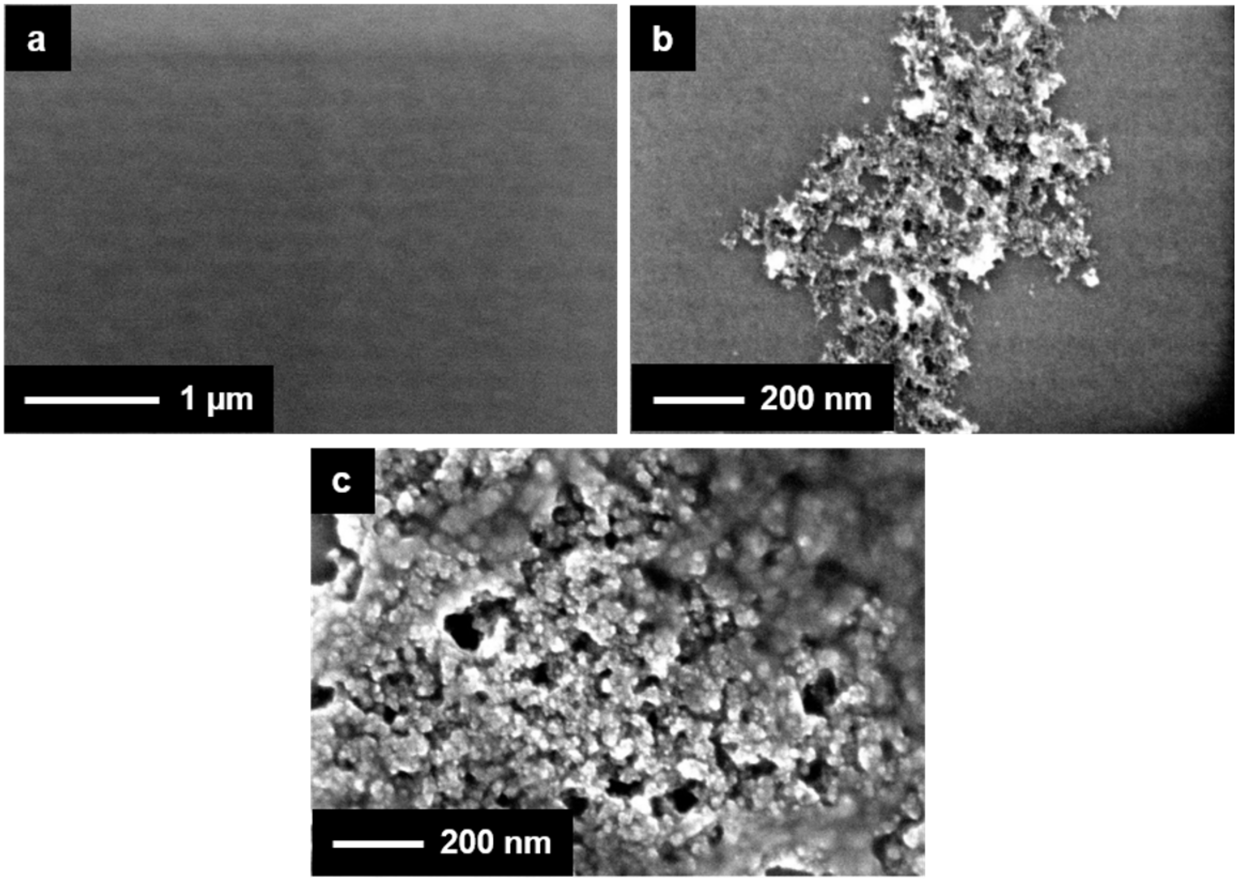


Figure S5. SEM images of (a) uncoated, (b) dip coated and (c) amide bonded NDs to Si wafer materials.