

# Size Influences the Effect of Hydrophobic Nanoparticles on Lung Surfactant Model Systems

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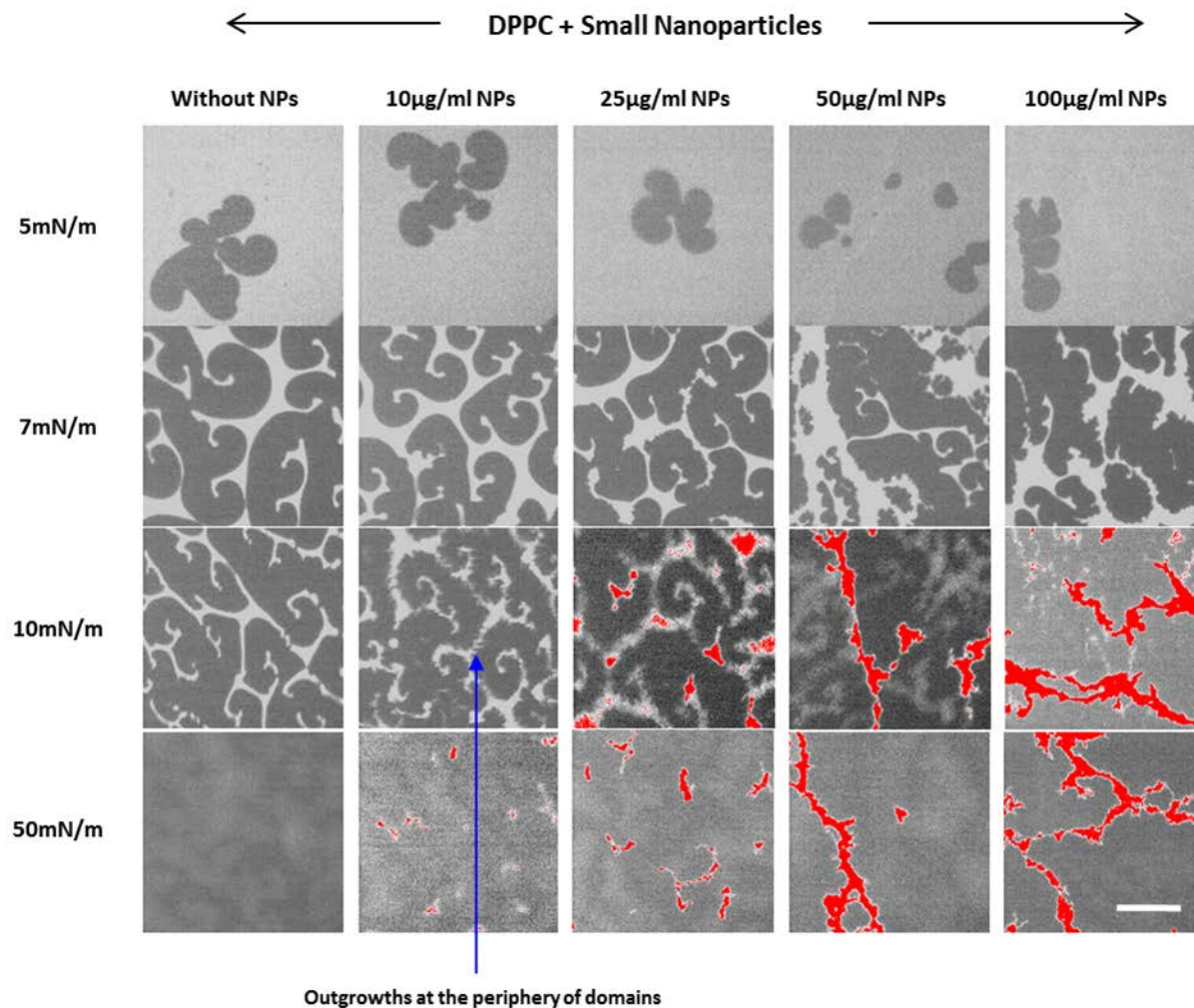
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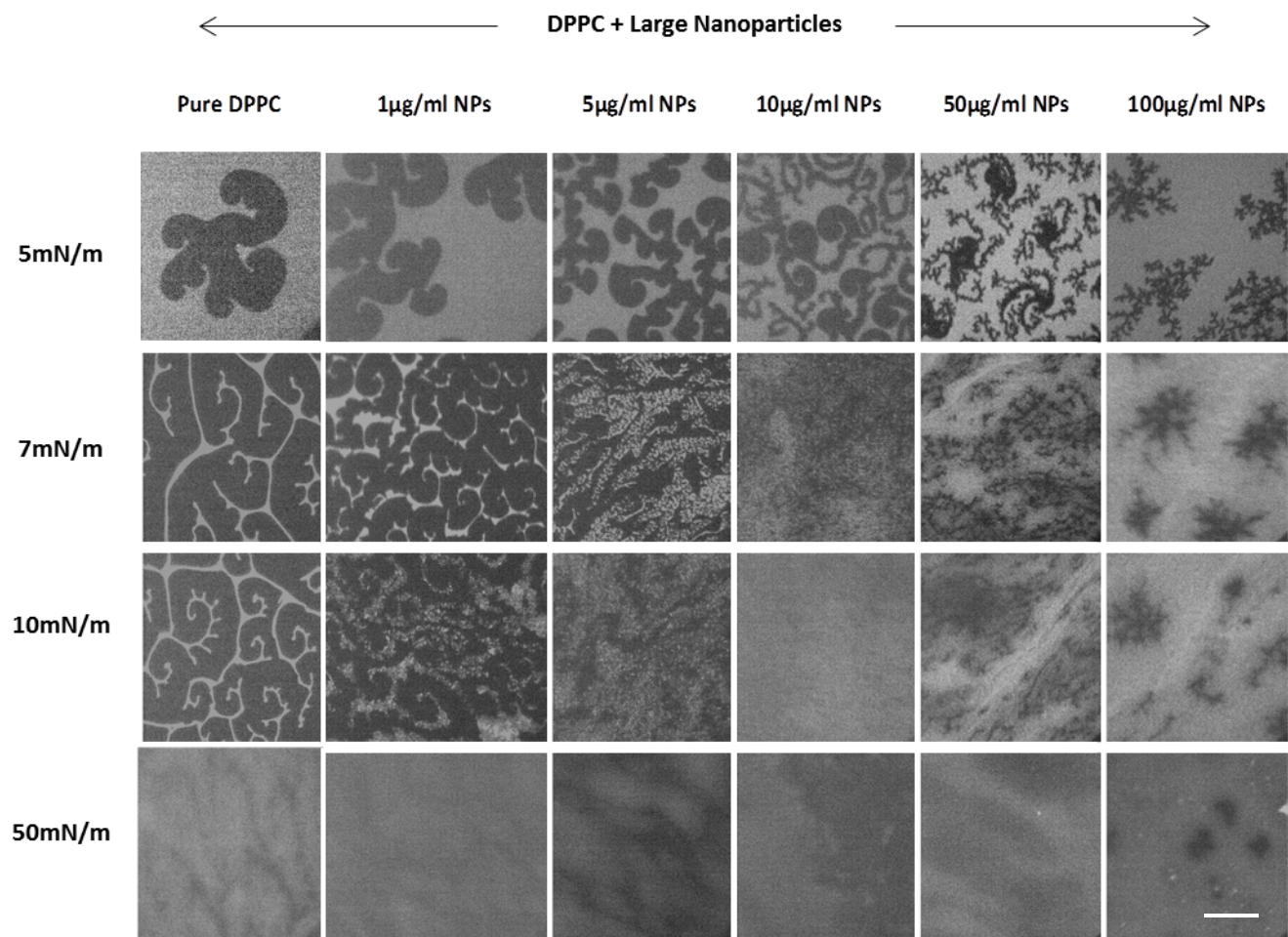
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Keywords: Lung Surfactant, nanoparticle size, Surface activity, atomic force microscopy, vesicle insertion kinetics, Multilayer protrusion structures.

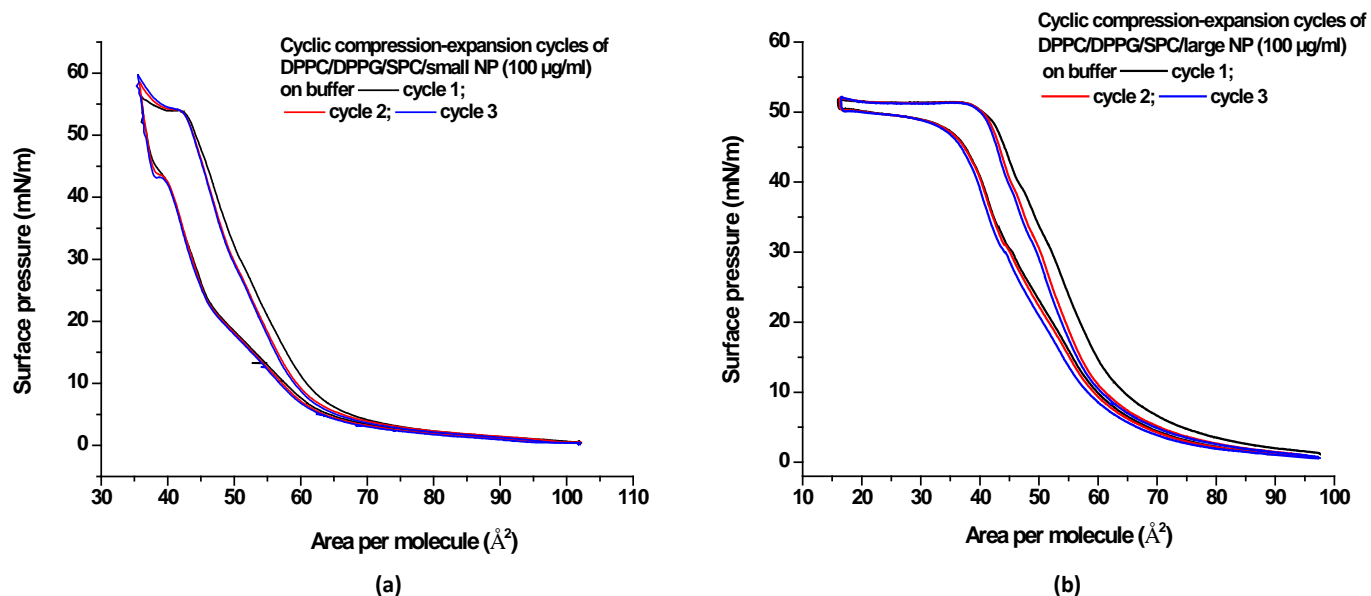
## Supporting Material



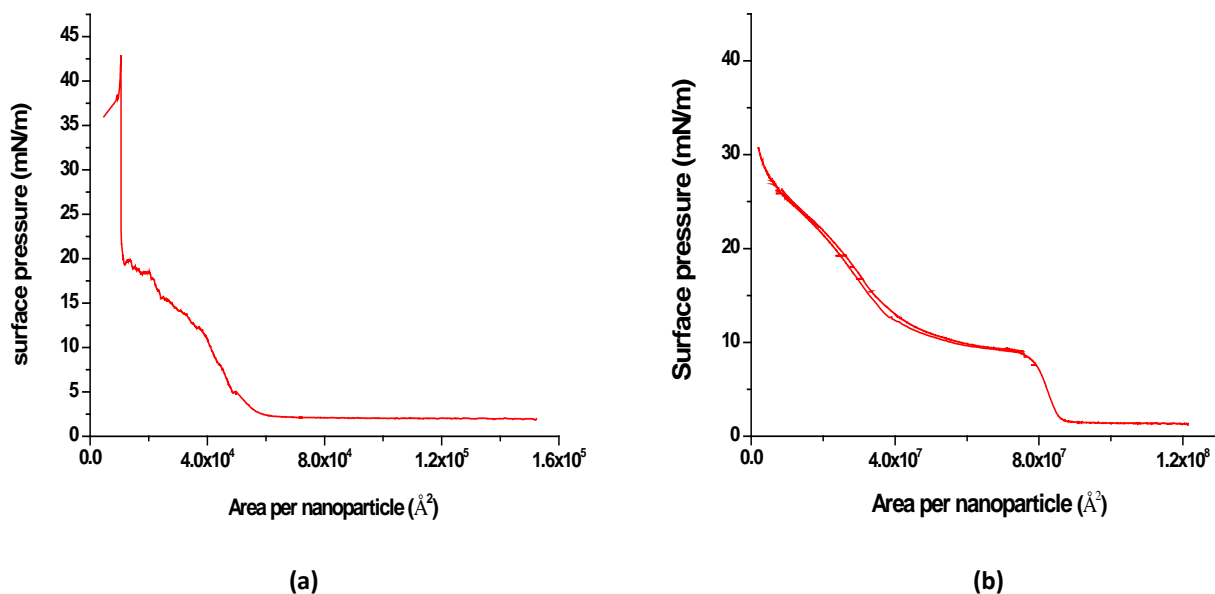
**Figure S1:** Epi-fluorescence microscopy images for DPPC in the presence of increasing concentration of small nanoparticles ( $\sim 12$  nm) on water as the subphase at  $20^\circ\text{C}$ . The DPPC monolayer is doped with 0.5 mol% BODIPY-PC which preferentially partitions into the liquid expanded phase. The images are taken at varying surface pressure values. Scale bar is  $50\ \mu\text{m}$ .



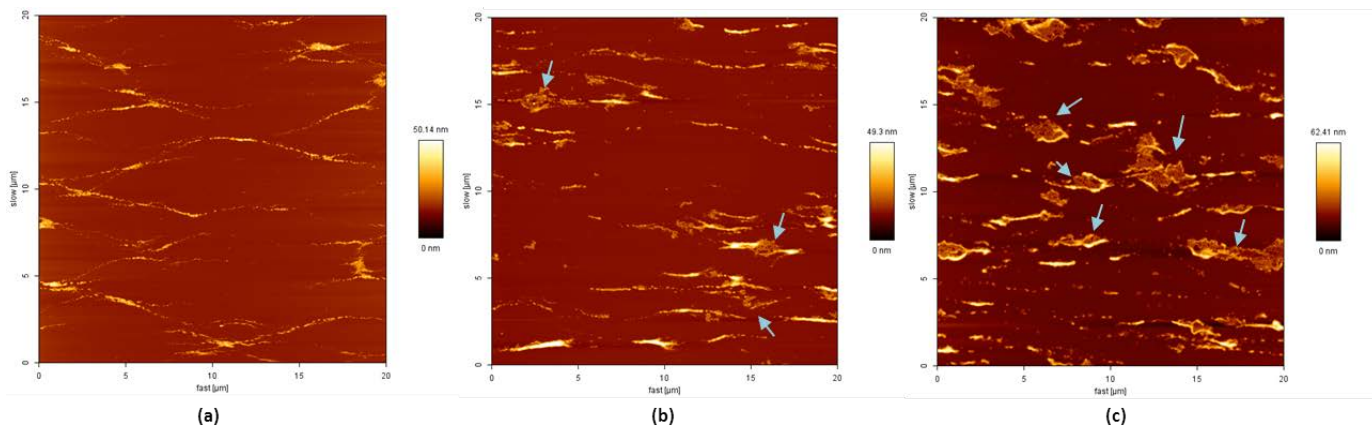
**Figure S2:** Epi-fluorescence microscopy images for DPPC in the presence of increasing concentration of large nanoparticles (~136 nm) on water as the subphase at 20°C. The DPPC monolayer is doped with 0.5 mol% BODIPY-PC which preferentially partitions into the liquid expanded phase. The images are taken at varying surface pressure values. Scale bar is 50  $\mu$ m.



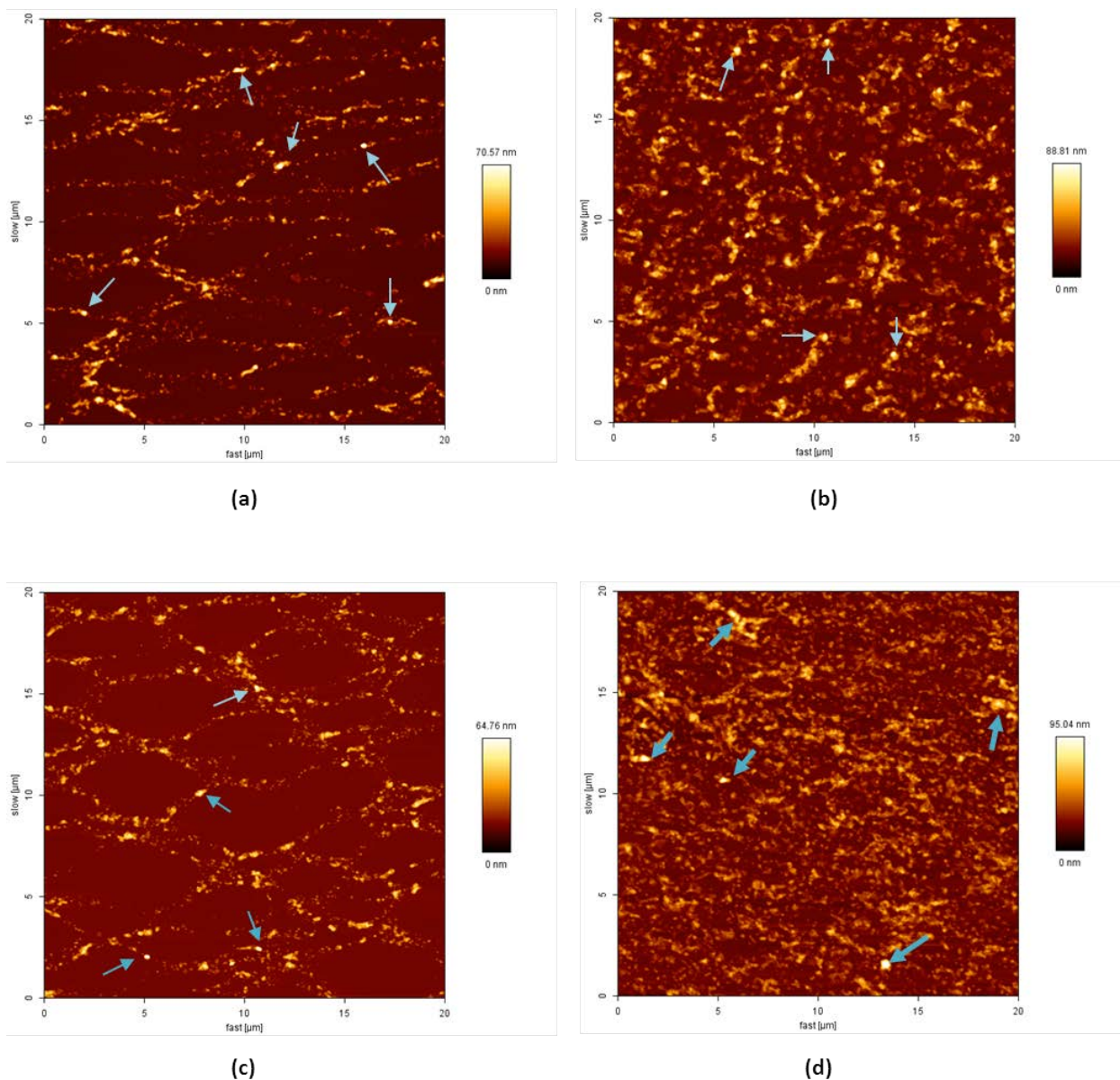
**Figure S3:** (a) Cyclic compression-expansion cycles for DPPC/DPPG/SPC/12 nm NPs (100  $\mu\text{g/ml}$ ). (b) Cyclic compression-expansion cycles for DPPC/DPPG/SPC/136 nm NPs (100  $\mu\text{g/ml}$ ) with 25 mM Hepes + 3 mM  $\text{CaCl}_2$  as the subphase at 20°C.



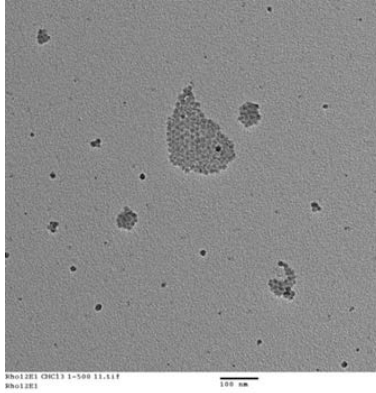
**Figure S4:** Surface pressure-area isotherm of (a) 12 nm nanoparticles ( $\sim 12$  nm) and (b) 136 nm nanoparticles with 25 mM Hepes + 3 mM  $\text{CaCl}_2$  as the subphase at 20°C.



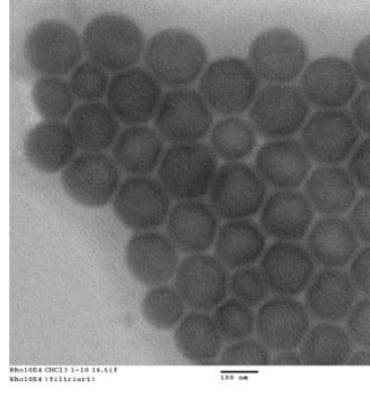
**Figure S5:** AFM topography images of (a) pure DPPC/DPPG/SPC (80:20:0.4 mol %) monolayer lipid film (b) with 50  $\mu\text{g/mL}$  12 nm nanoparticles (c) with 100  $\mu\text{g/mL}$  12 nm nanoparticles transferred at plateau region. The film was compressed on 25 mM Hepes + 3 mM  $\text{CaCl}_2$  as the subphase at 20°C. The clusters of nanoparticles around the protrusion structures are marked by arrows.



**Figure S6:** AFM topography images of DPPC/DPPG/SPC (80:20:0.4 mol %) monolayer lipid film with (a) 50 μg/mL 136 nm nanoparticles at initial plateau region (b) 50 μg/mL 136 nm nanoparticles at end plateau region (c) 100 μg/mL 136 nm nanoparticles at initial plateau region (d) 100 μg/mL 136 nm nanoparticles at end plateau region. The film was compressed on 25 mM Hepes + 3 mM CaCl<sub>2</sub> as the subphase at 20°C. The clusters of nanoparticles around the protrusion structures are marked by arrows.



(a)



(b)

**Figure S7:** TEM micrograph images of (a) 12 nm nanoparticles (b) 136 nm nanoparticles. Samples were deposited from chloroform. Scale bar is 100 nm.