

Supplementary Information

Centrifugation-based assay for examining nanoparticle-lipid membrane binding and disruption

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AgNP sedimentation behavior

The sedimentation behavior of AgNPs in the absence of vesicles was analyzed based on the surface plasmon resonance peak area of the supernatant phases before and after centrifugation. The percentage (%) sedimentation shown in Table S1 depicts the inherent sedimentation behavior of the AgNPs during the vesicle binding assay, which was accounted for in equation 1 when determining the R_{SPR} ratio.

Table S1. Sedimentation behavior of AgNP with centrifugation (6000 g, 15 min).

	% Sedimentation ^a		
	Ag-PEG	Ag-COOH	Ag-NH
DI water	21	9	19
10 mM NaCl	19	19	20
100 mM NaCl	16	14	13

AgNP binding to fluid phase vesicles

The centrifugation assay was applied to fluid phase vesicles composed of zwitterionic dioleoylphosphatidylcholine and anionic dioleoylphosphatidylglycerol (DOPC/DOPG). These vesicles provided a fluid phase analog to the gel phase DPPC/DPPG vesicles. Results from the centrifugation assay confirm AgNP binding when fluid vesicles and AgNPs are oppositely charged. When like charged, little AgNP binding is observed to DOPC/DOPG vesicles. These initial results are qualitatively similar to DPPC/DPPG and show that the approach is applicable to both gel and fluid phase vesicles. Differences in AgNP binding to gel and fluid phase membranes are currently being examined in more detail.

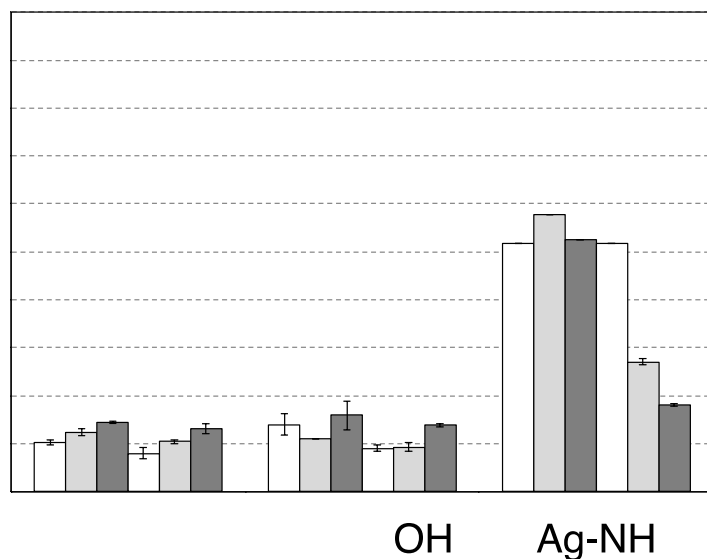


Fig. S1. Ratio of the SPR absorbance before and after centrifugation, R_{SPR} , for AgNPs added to DPPC/DPPG (a) and DOPC/DOPG (b) at PC:PG ratios of 3:1 in DI water as a function of the nanoparticle to vesicle ratio, NP:V. R_{SPR} takes into account the sedimentation behavior of the nanoparticles alone. Vesicles alone did not sediment at the conditions employed. Standard deviation bars based on triplicate experiments.

Ag-NH + DPPC/DPPG vesicles without centrifugation

Cryo-TEM analysis was performed on cationic Ag-NH particles added to anionic DPPC/DPPG vesicles (3:1) at a NP:V ratio of 4.0 without centrifugation. The results show AgNP binding and aggregated, distorted, and ruptured vesicles, which were also observed for the same vesicle-AgNP system in the sediment phase after centrifugation. Although the effects of centrifugation on vesicle structure cannot be completely discounted, these results suggest that the changes in vesicle structure due to AgNP binding were driven by adhesive forces.

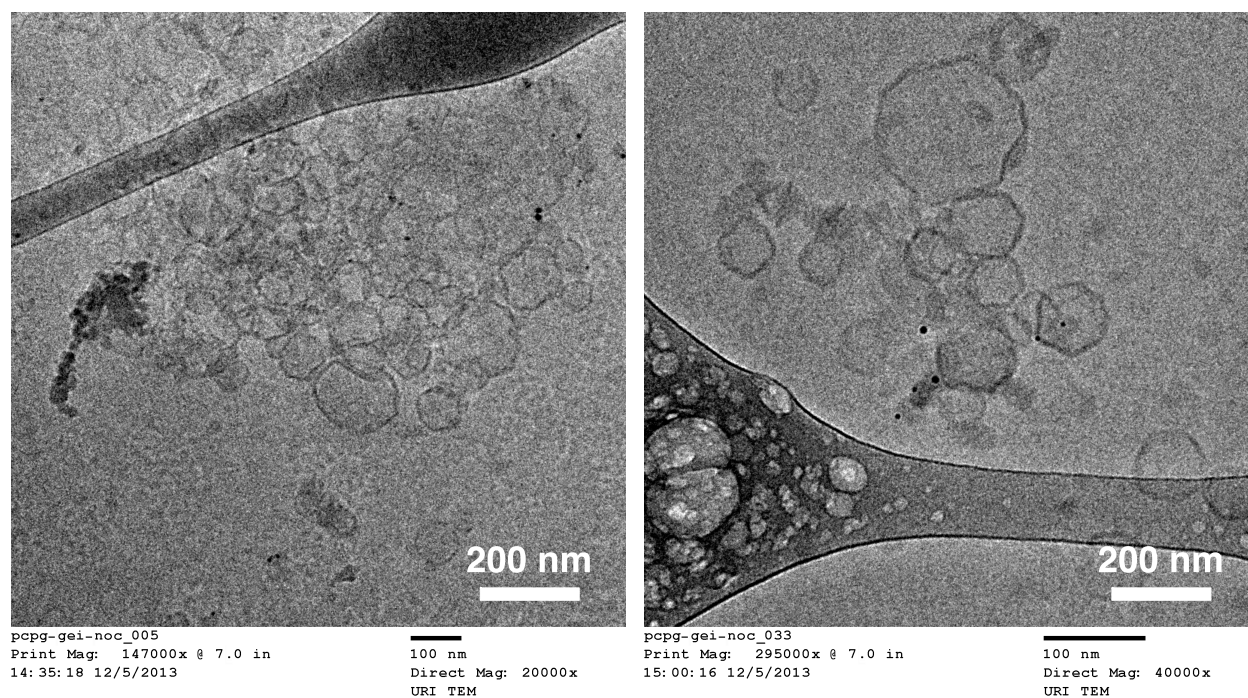


Fig. S2. Cryo-TEM micrographs of DPPC/DPPG (3:1) + Ag-NH at a NP:V ratio of 4.0 without centrifugation. The scale bars represent 200 nm.