Metallization of Phospholipid Nanodiscs for Surface-Enhanced Raman Scattering

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Detailed knowledge of the molecular structure of membrane proteins represents a basic prerequisite for modern drug design. However, due to their hydrophobic parts, membrane proteins are in general insoluble and difficult to crystallize which imposes serious limitations for conventional protein structure determination techniques. Therefore, this work aimed at developing a novel type of substrate for surface-enhanced Raman scattering (SERS) to enable the structural analysis of membrane proteins in their native environment. To this end, we have adapted a recently introduced approach for the DNA-templated growth of metal nanoparticles [1] in order to metallize self-assembled phospholipid nanodiscs (NDs) (see Fig. 1).
Phospholipid NDs are water-soluble planar phospholipid bilayer segments surrounded by two copies of an amphipathic helical protein (membrane scaffold protein, MSP) which exhibit a well-defined size of about 10 nm and enable the reconstitution of single membrane proteins [2,3]. Here, we have assembled negatively charged nanodiscs from DMPG lipids and decorated them with positively charged gold nanoparticles (AuNPs). Electroless gold deposition was then employed to fuse the immobilized AuNPs together to form metallized gold nanodiscs (AuNDs). The so synthesized AuNDs yield significant Raman enhancement and thus represent SERS-active substrates which may enable the structural investigation of reconstituted membrane proteins by SERS.

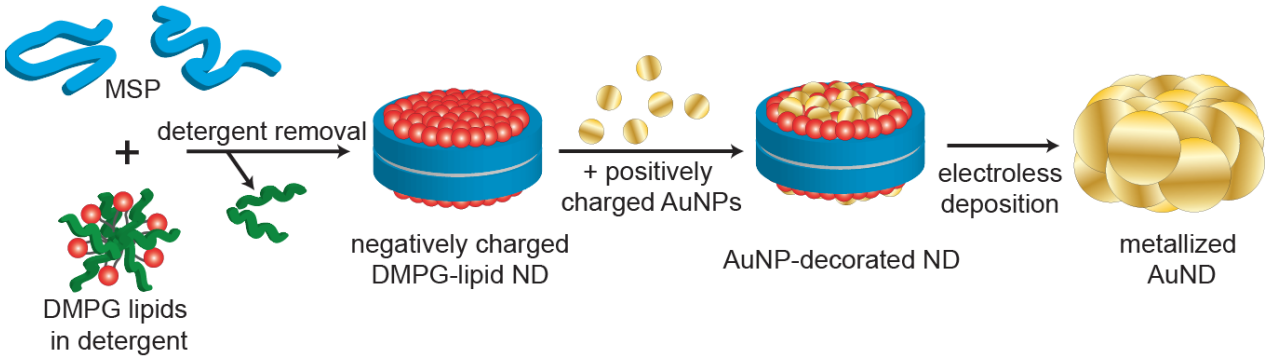

Fig. 1: *Strategy for the synthesis of metallized gold nanodiscs.*

[1] R. Schreiber, et al. Small 7 (2011) 1795–1799.
[2] T. H. Bayburt, Y. V. Grinkova, S. G. Sligar, Nano Lett. 2 (2002) 853–856.

[3] T. H. Bayburt, S. G. Sligar, FEBS letters 584 (2010) 1721–1727