Aggregation Enhanced Emission of Self-Assembled Au *Nano*clusters in Lipid *Nano*discs (NANO²)

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Abstract:

Bicelles (an acronym for "bilayered micelles") are normally composed of two or three lipid components having a discoidal shape with a diameter of 20 ~ 50 nm and a bilayer thickness of ~ 5 nm. Recently, an in vitro cellular study has demonstrated that bicelles have much greater cellular uptake than liposomes, which have been used as commercial drug delivery carriers for decades. Hence, bicelles have great potential to improve efficacy of lipid-based nanocarriers for theranostics. Several advantages of bicelles are the robustness of the self-assembly, easy surface conjugation with various functional groups, simple process for scalable manufacturing. Our laboratory has used the bicellar platform to entrap atomically precise Au clusters, whose surface is conjugated with hydrocarbon chains, as a nano-in-nano carrier (henceforth referred as $NANO^2$). Many unique and impactful properties have been observed. First, encapsulation leads to a more structurally stable discoidal morphology. Furthermore, a novel "aggregation enhanced emission" phenomenon has been observed and the origin of the enhancement has not been clearly understood by far. Last but not least, the $NANO^2$ shows aggregation at Endoplastic Reticulum (ER) and Golgi apparatus (GA) after cellular uptake, providing possible pathway for drug delivery specifically to ER and GA.