Self-Assembly of Plasmonic Nanoparticles Under Confinement

Luis M. Liz-Marzán

CIC biomaGUNE, Basque Research and Technology Alliance (BRTA), Paseo de Miramón 182, Donostia-San Sebastián, Spain
Ikerbasque, Basque Foundation for Science, 48013 Bilbao, Spain

llizmarzan@cicbiomagune.es

Abstract (Century Gothic 11)

Self-assembly of nanoparticles comprises spontaneous organization of the building blocks into ordered structures by thermodynamic and other constraints. Among other potential forces driving self-assembly, hydrophobic interactions are non-specific interactions, emerging when water molecules rearrange as two hydrophobic species come close to each other. Prediction of hydrophobic interactions at the level of nanoparticles (Brownian objects) remains challenging, because of uncontrolled diffusive motion of the particles. We have developed a general methodology for solvent-induced, reversible self-assembly of gold nanoparticles into 3D clusters with well-controlled sizes. Theoretical description of the process confirms that hydrophobic interactions are the main driving force behind nanoparticle aggregation. Even though self-assembly is then reversible, a limiting factor in this process is the need for constant sample dilution in assembly/disassembly cycles. Changes in nanoparticle concentration alter the kinetics of the subsequent assembly process, limiting optical signal recovery. This problem can be solved by confining hydrophobic nanoparticles within permeable silica nanocapsules, so that the number of nanoparticles participating in cyclic aggregation remains constant, despite of bulk changes in the solution. When this process is applied to plasmonic nanoparticles, highly reproducible plasmon band shifts are obtained at different solvent compositions.

References

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