Design of Colloidal Building Blocks: Merging the Advantages of Silver and Gold

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We present a general synthesis approach to achieve narrow distributions in size, chemical variability, and oxidant stability, which are well-known for gold nanoparticles, while obtaining the advantageous plasmonic properties of silver. This is achieved by consequent control of the growth via balancing the reduction potentials and externally enforcing adequate reaction kinetics ("living growth conditions").[1]

Exploiting gold cores as seeds enables the controlled synthesis of various silver morphologies in aqueous dispersions. Exploiting specific gold colloids as seeds for silver overgrowth via facet-selective capping allows for the preparation of silver nanocubes[2] and silver nanowires[1] with sharp edges/tips and extraordinary narrow distributions (see Figure). Hence, we selected seed-mediated growth of spherical single-crystalline gold nanoparticles and pentatwinned gold nanorods as seeds, respectively.

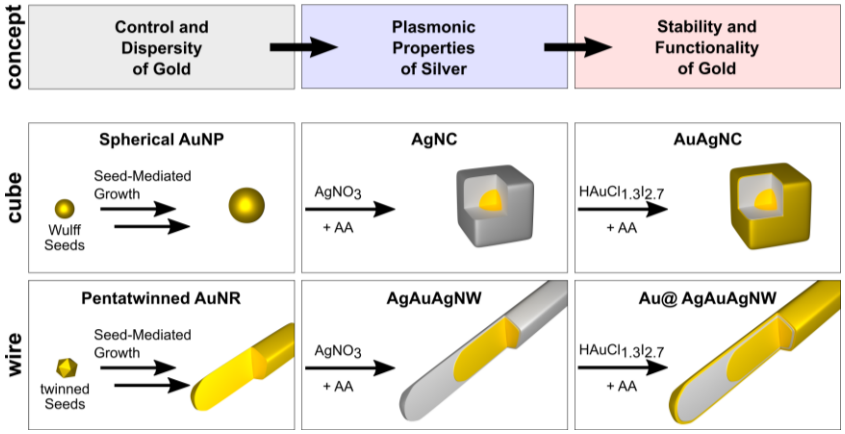

Figure 1. General synthesis concept for the designed colloidal silver nanoparticles. The controlled synthesis of narrowly distributed and pure gold nanoparticles are exploited as seeds in this synthesis concept. By the introduced living growth conditions, these features can be inherited to particles with the superior plasmonic properties of silver. Finally, the silver is protected by an optically invisible gold layer in order to suppress oxidation reactions.

Finally, we achieved a sub-skin depth gold shell, which guarantees oxidant stability, but also facilitates chemical functionalization protocols in a fully aqueous system. To verify the homogeneity and distribution of the obtained bimetallic particles we performed comprehensive characterization by HAADF-TEM, EDX mapping, SAXS, UV-vis-NIR, EELS and FDTD.

[1] M. Mayer et al., *Nano Lett.* **15** (2015), 5427.
[2] M. Mayer et al., *Angew. Chem. Int. Ed.* **56** (2017), 15866.

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