High Yield Seeded-Growth of Anisotropic Gold Nanoparticles

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Although recent progress of seeded-growth has made available an extensive library of anisotropic metal nanoparticles [1], the chemical complexity of the growth solution, often involving organic additives [2], and the structural instability of the seeds hinder the quest for high quality products. For the sake of synthetic simplicity, merging different synthetic protocols by finding common growth routes, is a mandatory step to reach a universal growth mechanism and reproducible fabrication. We show here that thermal treatment of small seeds results in extensive twinning and a subsequent drastic yield improvement (>85%) in the formation of pentatwinned nanoparticles, with pre-selected morphology (nanorods, bipyramids and decahedra) and aspect ratio [3]. The "quality" of the seeds thus defines the yield of the obtained nanoparticles, which in the case of nanorods avoids the need for additives such as Ag^+ ions. This modified seeded growth method also improves reproducibility, as the seeds can be stored for extended periods of time without compromising the quality of the final nanoparticles. Additionally, minor modification of the seeds with Pd allows their localization within the final particles, which opens new avenues toward mechanistic studies. All together, these results represent a paradigm shift in anisotropic gold nanoparticle synthesis.

References

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[2] L. Scarabelli, M. Grzelczak, L.M. Liz-Marzán, Chem. Mater., 25 (2013) 4232
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Figures

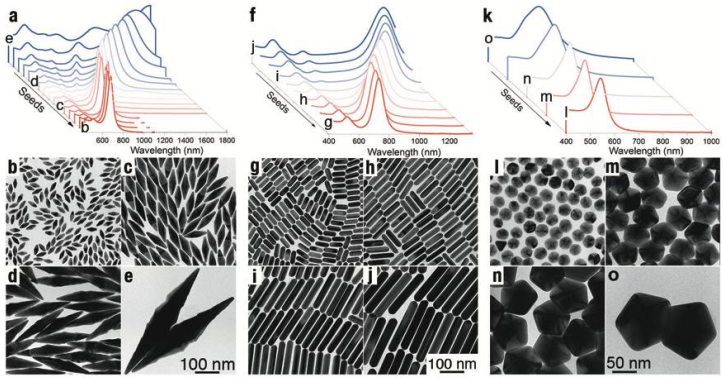

Figure 1: Universal character of thermally-treated seeds. Effect of seed concentration on the growth of bipyramids (a-e), nanorods (f-j) and decahedra (k,o). (a,f,k) UV-Vis-NIR spectra of colloids prepared with different seed concentrations and representative TEM images of nanoparticles prepared in a single growth step from different amounts of seeds.