

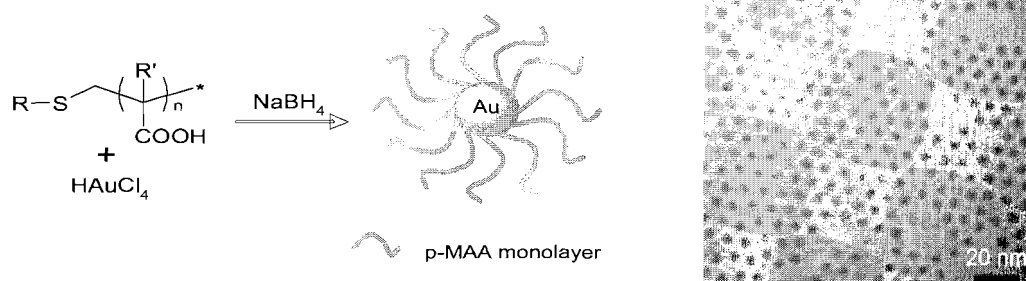
Transition from non-fluorescent to fluorescent water-soluble polymer-capped gold nanoparticles.

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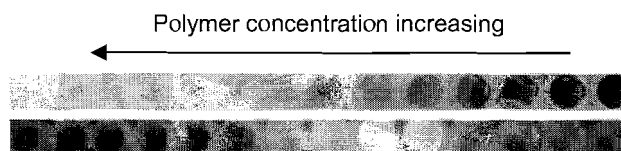
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The formation of small metal or semiconductor colloids has been intensively investigated in the last few decades because of the unique properties that they exhibit on the nanometer scale. Gold nanoparticles are especially interesting candidates as they may be used for chemical, physical or biological applications. These applications require an exquisite control over their size and surface properties. This is generally achieved by varying the nature of their protective monolayer.

Herein, we describe how poly(methacrylic acid) (p-MAA) with a variety of molecular weights and thiol-containing end-groups can be used to precisely control the size of gold nanoparticles. The nanoparticles are monodisperse and their size can be adjusted between one and five nanometers by varying the polymer concentration.^{1,2}



A transition from non-fluorescent to fluorescent nanoparticles occurs at average particle diameters between 1.7 nm and 1.1 nm. We demonstrate unambiguously that the fluorescence originates from the polymer-capped nanoparticles and not from the polymer itself or from polymer-Au(1) complexes. We also report, for the first time, that, contrary to semi-conductor quantum dots, fluorescent gold nanoparticles are subject to photobleaching. Using a variety of characterization techniques (Photothermal Microscopy, XPS, High-Resolution TEM, Molecular Modelling, Fluorescence Recovery After Photobleaching, ICP-AES), we demonstrate that the most fluorescent nanoparticle sample has a 3% quantum yield, a 6.9 nm hydrodynamic diameter, and is composed of a 1.1 nm gold core surrounded by, on average, 4-5 polymer chains.



References

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- (2) Wang, Z.; Tan, B.; Hussain, I.; Schaeffer, N.; Wyatt, M. F.; Brust, M.; Cooper, A. I. *Langmuir*, **2007**, 23(2), 885-895.