Gold Nanoparticles and Recombinant Elastin-like Polymers: Synthesis of Smart Hybrids

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Abstract

Recently, control over surface interactions of gold clusters and biomolecules is being pursued for potential use in biomedical and biosensing applications [1]. Furthermore, one and two dimensional assemblies of gold clusters allow for the creation of nanoconducting networks, direct visualization of biomolecules or control of plasmonic coupling [2]. Within the third dimension in space, gold clusters embedded in polymeric micelles and vesicles have been proposed as catalysts and drug delivery vehicules [3]. On the other hand, our research group has a vast experience in the production of smart materials based on recombinant elastin-like polymers (ELPs) [4]. Recombinant ELPs exhibit conformational changes in their structure in response to external stimuli by a LCST-like (low critical solubilization temperature) mechanism. Furthermore, interesting self assembled architectures such as nanopores, micelles and vesicles are exhibited by these biocompatible proteinaceous polymers.

To this extent, it appeared attractive to us to explore the synthesis of ELP´s tailored with gold clusters and investigate the potential applications of these hybrid systems. In this sense, a two fold aim was pursued. Firstly, the synthesis of gold nanoparticles mediated by ELP´s allowed for the investigation of the surfactant properties exhibited by these biopolymers and their subsequent role in controlling nanoparticle growth and aggregation during nanoparticle formation. And secondly, it is possible to investigate the covalent tailoring of gold clusters with ELP´s that exhibit sulfhydril functions for the development of functional materials that exhibit features of their mother components.

Here, we report on our research efforts on the synthesis of thermal and pH responsive gold clusters embedded in a recombinant matrix that exhibit reversible pH and temperature aggregation. In addition, the formation of defined and organized nano and micro structures in a biopolymer mediated assembly of gold clusters has been achieved. Astoundingly, the architectures observed by transmission electron microscopy (TEM) include the formation of gold beaded nanochains and gold clusters transported within polymer vesicles (**Fig. 1, 2**)
Furthermore, spectroscopic measurements have been carried out to investigate the structure-properties relationship of the hybrids synthesized. Noteworthy is that gold-ELP´s conjugates exhibit thermo and pH sensitive optical properties (**Fig. 3**) suitable for optical sensors and biological applications.

References:

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4)Rodríguez-Cabello, J. C.; Reguera, J.; Girotti, A.; Arias, F. J.; Alonso, M., *Adv. Polym. Sci*. **2006**, 200, 119-167.

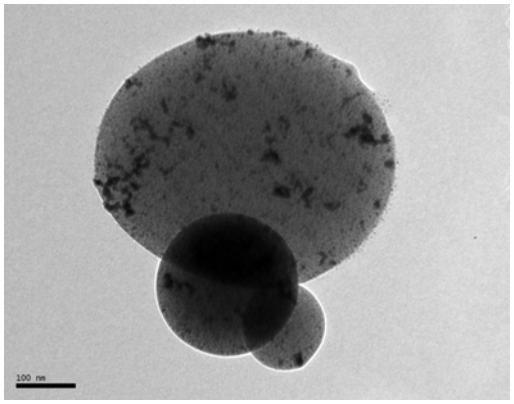

Figure 1: TEM micrograph of recombinant polymer vesicles exhibited by gold-ELP hybrid.

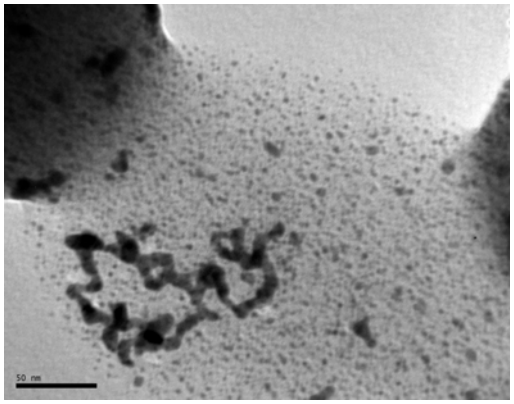

Figure 2: TEM micrograph of gold beaded nanochains contained within polymer vesicles of gold-ELP hybrid.

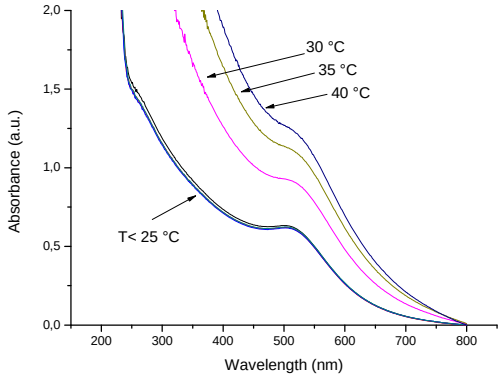

Figure 3: Light absorption exhibited by a gold-ELP hybrid as function of temperature.