Microsc. Microanal. 18 (Suppl 5), 2012

doi:10.1017/S1431927612012937

Microstructural Characterization of Silver Nanoparticles for Biomedical Applications

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There is a growing interest in nanoparticles as carriers of chemotherapeutic agents in order to improve their administration and minimize their side effects [1]. Despite the fact that silver nanoparticles can be conjugated to therapeutic agents [2], offering additionally advantages due their unique and tunable optical properties, few examples have been described yet.

The primary aim of the current study was to synthesize and characterize silver nanoparticles capable of conjugating to Camptothecin (CPT), a potent chemotherapeutic agent, which suffers from poor in vivo anti-tumor efficacy owing to its poor water-solubility and chemical instability [3]. In this work citrate monolayer-protected silver nanoparticles have been prepared, characterized by electron microscopy, and their properties as drug delivery system assessed. Nanoparticles were synthesized by reduction of silver nitrate with trisodium citrate in aqueous medium. The UV-Vis spectra of the silver nanoparticles aqueous solution display a band with a maximum at 422 nm, corresponding to the silver nanoparticles Surface Plasmon.

Microstructural characterization was carried out by using a TEM microscope (Philips CM200) at 200 kV. Droplets of the suspension were deposited onto a C film grid. The morphology and microstructure found are shown in Figure 1. A collection of nanoparticles can be clearly observed that differ in shape and size. There are well-defined rods, platelets and some smaller spheres. The rod length varies from one to five hundred nanometers, and the diameter from 30 to 80 nanometers. The platelets present different facets with an average particles size of 70 nm and the sphere size is around 30 nm. There is very light contrast embedding the metal nanoparticles that could be assumed as the citrate monolayer.

Silver nanoparticles were loaded with CPT by incubation, protected with polyvinylpyrrolidone and conjugated with monoclonal antibody to epidermal growth factor receptor (mAb-EGFR), highly expressed on non-small cell lung cancer cells, through carbodiimide-mediated coupling reactions. An uptake efficiency of 3 mg CPT per mg nanoparticle was determined using UV-Vis spectroscopy. non-small lung cancer cell line cultures (H-460) were incubated with CPT (Figure 2 B), and nanoparticles loaded with CPT and conjugated to mAb-EGFR (Figure 2 C), and apoptosis was assessed by observing nuclei fragmentation by Hoechst staining.

According to these results, silver nanoparticles loaded with CPT and conjugated to mAb-EGFR provide an efficient and targeted delivery system.

References

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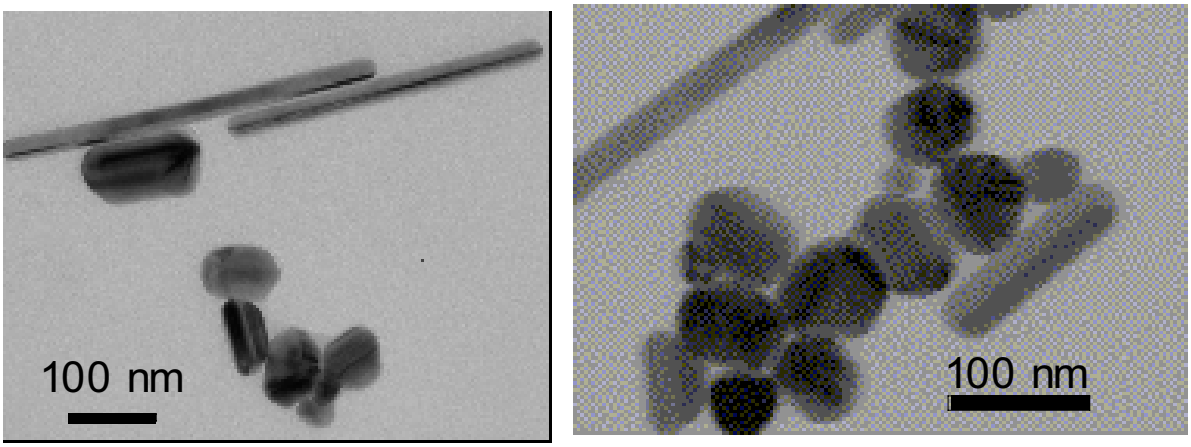

Figure 1. Microstructural characterization of silver nanoparticles.

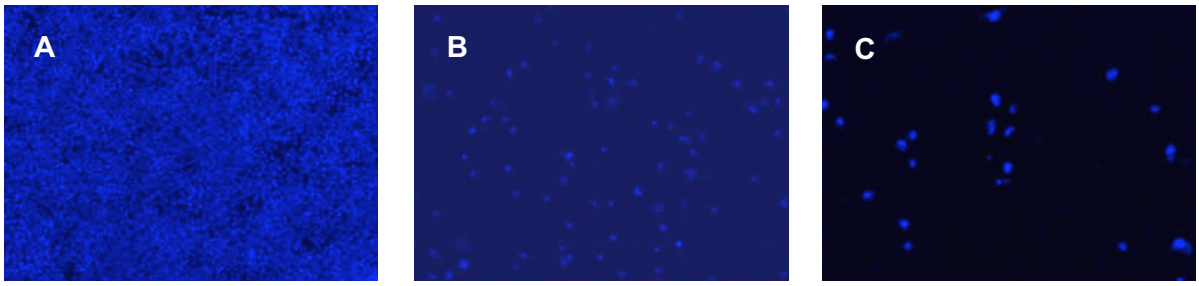

Figure 2. Phase contrast microscopy images of H-460 cultures: (A) control, (B) treated with CPT, and (C) treated with silver nanoparticles loaded with CPT and conjugated to mAb-EGFR. Images were taken 72 h after treatment.

We thank financial support from the Junta de Andalucía (FQM-6615, PI0070 and FQM319).

https://doi.org/10.1017/S1431927612012937 Published online by Cambridge University Press