Bis-imidazolium amphiphile-based gold nanoparticles for drug delivery

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In recent years we have assisted to the rapid evolution of nanotechnology and its applications in many fields, of which medicine is an example. One of the areas of interest is the development of nanocarriers for drug delivery. Gold is among the most common used materials to prepare nanoparticles, because of its physical and chemical characteristics [1]. Gold nanoparticles can be synthesized by the Brust-Schiffrin method, which allows obtaining nanoparticles with narrow size range: It is based in a two-phase system (water /toluene), where a phase-transfer agent is needed to transfer gold ($AuCl_4^-$) from water to toluene, where it is reduced by $NaBH_4$ and stabilized by a thiol, which has a natural affinity to interact with gold. The size of the nanoparticles can be controlled by the thiol:$AuCl_4^-$ proportion [2].

In our group we synthesized an amphiphilic imidazolium-based molecule, capable of interacting with anions [3] and gold [4]. This molecule was successfully used to prepare gold nanoparticles with a size ca. 8 nm (see Figure 1), a novel procedure where the bis-imidazolium amphiphile plays three roles: transfer agent promoting the synthesis, stabilizer of the gold nanoparticles, and due to its interaction with anions, complexation of negatively charged drugs and therefore role as a delivery vehicle.

We present here the results of the synthesis of gold nanoparticles with this novel amphiphilic molecule, as well as the release profile of a model drug that was associated to these nanoparticles. Given the fact that their purpose is to serve as vehicles for delivery of drugs in the human body, the determination of the toxicity is of great importance. It was studied the cytotoxicity and the genotoxicity of the nanoparticles, and also their internalization into human cells (see Figure 2).

The potential application of the synthesized nanostructures to other types of therapy relies on the development of a method to obtain water soluble nanoparticles, a goal which is also being pursued in our group.

References

[1] E. Boisselier, D. Astruc, Chem. Soc. Rev., **38** (2009) 1759
[2] M. Brust, M. Walker, D. Bethell, D. J. Schiffrin, R. J. Whyman, J. Chem Soc., Chem. Commun. **7** (1994) 801
[3] E. Alcalde, N. Mesquida, L. Pérez-García, Eur. J. Org. Chem. **17** (2006) 3988
[4] C. Sporer, L. Casal, D. Caballero, J. Samitier, A. Errachid, L. Pérez-García, Sensor Lett. **7** (2009) 757

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Figures

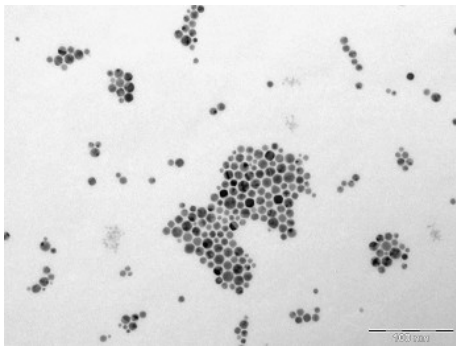

Figure 1: TEM micrograph of gold nanoparticles stabilized with amphiphilic molecule

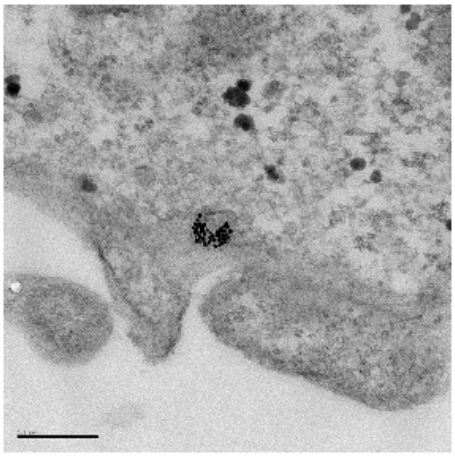

Figure 2: TEM migrograph of gold nanoparticles inside Caco-2 cells after 30 minutes