Simplified tetraethylene oxide-mediated synthesis of gold nanoparticles and their internalization by cancer and neuronal cells

Anne Juliette Trouiller1, Emile Béré2,3, Joanna Kalaani2, Emilie Evanno4,5, Benoit Fouchaq5, Joëlle Roche4,5, Laetitia Prestoz2, Teko W. Napporn1, Philippe Bertrand1*.

1) University of Poitiers, IC2MP UMR 7285 CNRS, 4 rue Michel Brunet B27, TSA 51106, 86073 Poitiers cedex 9, France.
2) INSERM U1084, Experimental and Clinical Neurosciences Laboratory, Cellular Therapies in Brain Diseases Group, University of Poitiers, 1 rue Georges Bonnet, TSA 51106, 86022 Poitiers cedex 9, France.
3) University of Poitiers, ImageUP Bâtiment B37, Pôle Biologie Santé, 1 rue Georges Bonnet, TSA 51106 86073 Poitiers cedex 9, France.
4) University of Poitiers, UFR/SFA, Pôle Biologie Santé, Bâtiment B36/37, 1 rue Georges Bonnet, TSA 51106, 86073 Poitiers cedex 9, France
5) Eurofins-Cerep, Le Bois l’Evêque, 86600 Celle – L’Evescault, France

For biological applications, gold nanoparticles synthesis requires non-toxic and biocompatible reagents, and excludes current techniques with toxic reagents like CTAB. Inspired by nanoparticle synthesis using polyethyleneoxide (PEO) in alkaline conditions1,2 or natural polysaccharide3,4 we developed a simplified and safe gold nanoparticles synthesis in aqueous tetraethylene oxide (PEO4). This synthesis was performed at 80°C and particles were obtained within 25 minutes. Moreover we observed that alkaline conditions are not necessary. Spherical and homogenous Nanoparticles were obtained with a mean diameter of 13 nm (Figure 1) and their absorbance was maximal at 538 nm. Based on zeta potential and XPS analysis, we proposed an updated mechanism of nanoparticles formation correlated with current bibliographic knowledge.

As nanoparticles are tools for cellular imaging and therapeutic delivery, we investigated the uptake of such nanoparticles in two different adherent cell lines: A549 non-small cell lung cancer cell line and PC-12 cell line derived from a transplantable rat pheochromocytoma and induced to differentiate into dopaminergic neurons. Indeed, as observed by electron microscopy these particles were able to enter these cells and localized in the cytoplasm.

Figure 1. Transmission electron microscopy of gold nanoparticles in solution

References

Corresponding author email: Philippe.bertrand@univ-poitiers.fr