

## **Polyphosphonate ligands: From synthesis to design of hybrid PEGylated nanoparticles toward phototherapy studies**

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The use of phosphonate ligands to modify the nanoparticle (NPs) surface has attracted strong interest in the

last years for the design of highly functional hybrid materials.

Here, we applied a methodology to synthesize bisphosphonates having functionalized PEG side chains with a specific length in order to design a novel class of hybrid nanomaterials composed by tetrakisphosphonate-complex-gold COOH-terminated PEG-coated NPs (Bis-PO-PEG-AuNPs). The synthetic approach consists in three steps: (1) Complexation between new phosphonate ligands (Bis PO) and tetrachloroauric acid (HAuCl<sub>4</sub>) to form gold clusters; (2) adsorption of COOH-

terminated PEG molecules (PEG) onto Bis PO-Au complex; (3) reduction of metal ions in that vicinity, growth of gold particles and colloidal stabilization. The obtained snow-shape-like hybrid nanoparticles have been characterized by ultra-violet/visible, Raman spectroscopies, and electron microscopy imaging, involving their optical properties and photothermal activity in pancreatic adenocarcinoma cancer cells (PDAC).

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