Copper Coordination Compounds Conjugated to Gold Nanoparticles as Innovative Anticancer Drugs: Structural Investigation Carried Out by Synchrotron Radiation-Induced Techniques.

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In recent years, the biomedical research of new metal-based anticancer drugs alternative to Pt(II) derivatives has been focused on complexes including, among other metals, gold, ruthenium, silver and copper. In particular, novel Cu-based antitumor agents have been studied according to the view that endogenous metals may be less toxic toward normal cells with respect to cancer ones (Figure 1a). In addition, copper(II) complexes of hexyl bis(pyrazol-1-yl) acetate ligands (Figure 1b) have been recently investigated for the development of a new and more efficient promoter for the Kharasch-Sosnovsky reaction to oxidize alkenes in allyl position. The synthetic strategy utilized ligands having soft donor atoms such as aromatic sp\textsuperscript{2} hybridized nitrogen of pyrazolyl derivatives. Since such coordination compounds have low solubility in aqueous medium, it is necessary to design a strategic approach allowing for drug delivery. By conjugating the copper complexes with hydrophilic gold nanoparticles, it is possible to improve their solubility and stability in water, and consequently to increase their bioavailability. Moreover, these drug delivery systems allow the investigation of a slow and controlled release of copper complexes.

Figure 1. Molecular structure of Copper(II) complexes

In this context, we investigated the molecular and electronic structure of a selection of Cu(II)-coordination compounds (see Figure 1 for the molecular structures of complexes A and B) by means of SR-XPS and NEXAFS spectroscopy; the oxidation state and the local coordination chemistry of the metal ion was probed by Cu K-edge XAFS analysed in the near edge (XANES) and extended (EXAFS) regions. The pristine ligands were also studied for sake of comparison. The combined use of complementary probes (XPS-NEXAFS-XAFS) is providing an accurate and reliable understanding of local coordination chemistry and electronic structure of Cu(II)-coordination compounds which are suitable to be the elementary building blocks to realize nanoassemblies by conjugation with hydrophilic AuNPs, along the route already successfully tested by some of us on model systems [1]. Here the results of multidisciplinary characterization of Cu(II)-coordination compounds and preliminary results on coordination compound/AuNPs interactions will be presented, discussing the further steps for the research.