CeO_2 nanoparticles as safe CT X-ray contrast imaging agents

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Use of X-ray computed tomography (CT) has increased dramatically over the last years in many countries owing to its availability, low cost and high resolution. An estimated 82 million scans were performed in the U.S. in 2016. However, a main concern about CT scans is the exposure to ionizing radiation. One study estimated that as many as 0.4% of current cancers in the U.S. are due to CTs performed in the past. Thus, an important issue is how to reduce the radiation dose during CT examinations without compromising the image quality. Contrast agents are regularly administered in order to improve image contrast. High Z-based nanoparticles have gained attention lately because they show notable advantages over commercial iodine-based compounds. For instance, they allow longer circulation times and deliver a large amount of heavy atoms[1]. In this work we present CeO_2 NPs as potential CT contrast agents. Cerium possesses high atomic number and electron density, it is biocompatible and CeO_2 NPs show antioxidant and anti-inflammatory properties, providing radioprotective capabilities [2]. In addition, given that the contrast enhancement depends both on the tube potential (kVp) and energy spectrum, Au-CeO_2 hybrides have also been prepared, increasing thus X-ray energy absorption range.

Firstly, it has been assessed the stability of the colloidal samples at the high concentrations required by the CT instruments (>100 mM), which are prone to aggregation and precipitation. In vitro CT results (Figure 1) indicate that, at equal molar concentrations, Ce-based NPs produce higher X-ray contrast than iodine. Additionally, we have observed that CeO_2 and Au-CeO_2 NPs act as a free-radical scavenger (Figure 2), reducing thus the radiation adverse effects of using metals in CT imaging [3].

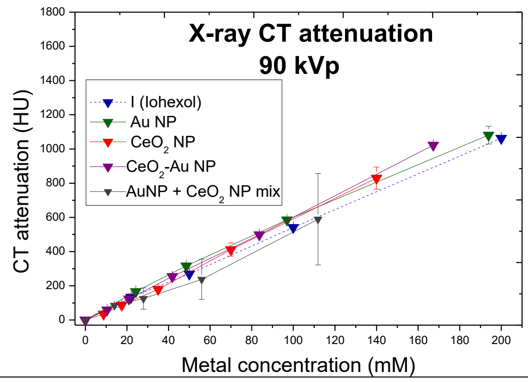

Figure 1: CT contrast (HU) as function of the metal concentration (mM).

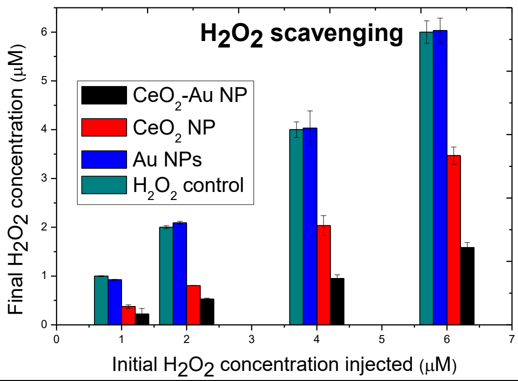

Figure 2: H_2O_2 scavenging tested with Amplex Red Assay

References

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