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DOSIMETRIC PROPERTIES OF HALLOYSITE NANOTUBES AND THEIR COMPOSITES WITH SILVER NANOPARTICLES

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Introduction: Halloysite nanotubes (HNT) with molecular form ($Al_2Si_2O_5(OH)_4.2H_2O$) have been used in different areas. Previous studies showed that HNT can be used as an electron paramagnetic resonance (EPR) dosimeter. Thereby, we sought to characterize and use HNT as dosimeters of ionizing radiation utilizing the optically stimulated luminescence (OSL) aiming to enhance the OSL intensity with silver nanoparticles.

Material and method: In this research it was used HNT from Sigma-Aldrich.

The HNT capacity of removing silver ions from solutions was explored to synthesize silver nanoparticles ancored to the HNT tubes. To this end, dispersions of HNT with silver nitrate solutions were kept at 353 K for 15 min. Thereafter, samples were centrifuged and annealed at 673 K for silver ions to reduce and form silver nanostructures.

Samples were characterized by Uv-Vis spectroscopy and transmission electron microscopy. Irradiations were perfomed with an x-ray tube (Magnum, Moxtek, USA) operating at 48 kVp and 0.2 mA. OSL was acquired using an OSL reader developed by the Laboratory of Dosimetry of the Physics Department at FFCLRP-USP. Samples were stimulated by a blue LED (maximum emission at 470 nm). OSL was detected in the 270–370 nm region by a photomultiplier coupled to a Hoya U340 optical filter.

Results: The dose response curve of pure HNT annealed at 673 K presented a linear behavior in the range 1-50 Gy range (Figure 1).

UV-Vis spectroscopy and TEM images confirmed the growth of silver nanoparticles anccored to the internal and external surfaces of the HNT. The OSL intensities (integral) for the HNT/Ag nanocomposites with different Ag concentrations and irradiated with 50 Gy are shown in Figure 2, revealing that as the silver concentration employed during the synthesis increased, the OSL intensity increased, reaching a pateau for concentrations above 0.05 $mol.L^{-1}$. This result could be attributed the presence of silver nanoparticles, which is known to cause plasmon-enhanced OSL.

Conclusions: HNT was characterized as an OSL dosimeter and verified that the synthesis method was successful and the presence of silver nanostructure enhaced the OSL signals.

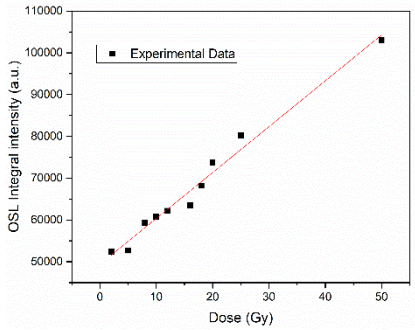

Figure 1: Dose-response curves of pure HNT.

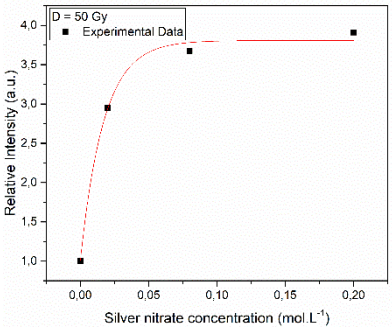

Figure 2: Dose-response with varying silver nitrate concentration.

References:

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