***Development of Manganese-doped Iron Oxide Nanoparticles Coated with Nickel Bis-dithiolene complex as a Theranostic Agent***

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The development of innovative theranostic agents has become of great interest in the scientific community, especially those in nanosize. Therefore, employing theranostics nanosystems that incorporate both therapeutic and diagnostic capabilities in one dose, are integrating in the biomedical field for individualized medicine. The nanosystem proposed is one that combines the magnetic capabilities of superparamagnetic nanoparticles to act as Magnetic Resonance Imaging (MRI) contrast agents, and the photothermal functionality of Nickel bis(dithiolene) complexes for Photothermal Therapy. MRI is a non-invasive diagnostic tool that takes advantage of the properties of magnetic particles to provide better spatial resolution. MRI contrast agents are divided into $T_1$ and $T_2$. Several inorganic nanoparticles are used as $T_2$ MRI contrast agents owing to their superparamagnetic properties. The nanoparticle here projected has two metal ions in its lattice, manganese (II) ($Mn^{2+}$), and iron (III) ($Fe^{3+}$), both metal ions have a large number of unpaired electrons and thus are suitable as MRI contrast agents: $Mn^{2+}$ as $T_1$ and $Fe^{3+}$ as $T_2$. $Mn^{2+}$ and $Fe^{3+}$ combined have the potential of becoming a dual MRI contrast agent, for example in the nanosystem of Mn-doped $Fe_2O_3$. Both metal ions are biocompatible and could be metabolized by the human body with low to none secondary effects after administration. The therapy component of the system is the photothermal agent. Photothermal Therapy (PPT) uses the near-infrared (NIR) light absorbed by a photosensitizer, like our substituted nickel bis-dithiolene complexes, and converts it to heat to nucleate the cancer cells. The heat created is expected to kill cancer cells by apoptosis and not necrosis to not affect the healthy cells. This together with the low toxicity of the Mn-doped $Fe_2O_3$ nanoparticles, the nanosystem will become a non-invasive theranostic agent that will be capable to monitor the cancer treatment effectively as it is being implemented.