# SYNTHESIS AND INVESTIGATION OF $GdPO_4$ BASED DIFFERENT CORE–SHELL STRUCTURES

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Conventional treatment for cancer is chemotherapy, which has many limitations such as drug stability and solubility. It also causes adverse side effects like hair loss, healthy cell death, loss of appetite and etc [1]. For these reasons the cancer research has attracted a lot of attention from scientists around the world. Many different approaches have been taking to battling the disease. These range from simple such as new and more effective cancer drug creation, improving the early stage detection of tumors to more complex such as immunotherapy and vaccines [2]. One other emerging treatment with high potential in both detection and treatment of cancer is the use of multifunctional nanoparticles. These particles could combine both luminescence bioimaging as well as act as contrast agents for MRI in order to improve the detection of cancer [3]. Also, as potential drug carriers for improved and more direct drug delivery. Due to the fact that nanoparticles tend to accumulate in the tumor itself rather than to disperse into the whole organism drugs would be delivered directly to the tumor and many side effects could be prevented. One of such potential compounds could be rare-earth element doped $GdPO_4$. Since $Gd^{3+}$ ions already have 7 unpaired f electrons they induce strong contrast during magnetic resonance imaging. In addition, doping by optically active ions such as $Eu^{3+}$, $Er^{3+}$, $Yb^{3+}$, and so on could be used for conventional or upconverting luminescence imaging. Anyway, there are still many problems related to both the production and the properties related to them. Such compounds have to match many of the needed criteria such as very small particle size of around 100 nm, not soluble in the biological fluid, do not degrade over time and so on [4]. However, the small particle size reduces the luminescence intensity of the particles, making one of the functionalities hampered. In order to avoid this drawback, core-shell structures are created [5]. $GdPO_4$ can also have several different crystal structures which could also influence the luminesce properties as well as particle stability, so much research is still needed to evaluate all of the factors involved.

In this work europium doped conventional luminescence as well as upconverting ytterbium and erbium/thulium co-doped $GdPO_4$ nanoparticles were using the hydrothermal method synthesized. Different shell structures of $GdPO_4$, $SiO_2$, and Ag were prepared. X-ray diffraction analysis was used to determine the thermal stability and purity of obtained samples. Scanning electron microscopy and transmission electron microscopy were used to determine the shape and size of particles. Luminescence measurements of particles and their solutions in the biological medium were performed.

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