World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:8, No:07, 2014

# Flame Spray Pyrolysis as a High-Throughput Method to Generate Gadolinium Doped Titania Nanoparticles for Augmented Radiotherapy

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**Abstract :** Gadolinium doped titania (TiO2:Gd) nanoparticles (NPs) can be activated by X-ray radiation to generate Reactive Oxygen Species (ROS), which can be effective in killing cancer cells. As such, treatment with these NPs can be used to enhance the efficacy of conventional radiotherapy. Incorporation of the NPs in to tumour tissue will permit the extension of radiotherapy to currently untreatable tumours deep within the body, and also reduce damage to neighbouring healthy cells. In an attempt to find a fast and scalable method for the synthesis of the TiO2:Gd NPs, the use of Flame Spray Pyrolysis (FSP) was investigated. A series of TiO2 NPs were generated with 1, 2, 5 and 7 mol% gadolinium dopant. Post-synthesis, the TiO2:Gd NPs were silica-coated to improve their biocompatibility. Physico-chemical characterisation was used to determine the size and stability in aqueous suspensions of the NPs. All analysed TiO2:Gd NPs were shown to have relatively high photocatalytic activity. Furthermore, the FSP synthesized silica-coated TiO2:Gd NPs generated enhanced ROS in chemico. Studies on rhabdomyosarcoma (RMS) cell lines (RD & RH30) demonstrated that in the absence of irradiation all TiO2:Gd NPs were inert. However, application of TiO2:Gd NPs to RMS cells, followed by irradiation, showed a significant decrease in cell proliferation. Consequently, our studies showed that the X-ray-activatable TiO2:Gd NPs can be prepared by a high-throughput scalable technique to provide a novel and affordable anticancer therapy.

**Keywords :** cancer, gadolinium, ROS, titania nanoparticles, X-ray
**Conference Title :** ICNN 2014 : International Conference on Nanotechnology and Nanomedicine
**Conference Location :** Prague, Czechia
**Conference Dates :** July 10-11, 2014