Synthesis of Magnetic Iron-Gold Core-Shell Nanoparticles using Solution Plasma

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Solution plasma process is an environmentally friendly and energy-efficient method of synthesizing metallic nanoparticles. The study focused on three main objectives; (i) study of voltage-current relationship during solution plasma for core-shell nanoparticles synthesis, (ii) determination of magnetic properties of the iron-gold core-shell nanoparticles and (iii) investigation of the effects of manipulated variables such as nanoparticles synthesis time and electrolyte concentration towards the voltage-current relationship and magnetic properties of the core-shell nanoparticles.

Through analysis, it was also observed that electrolyte concentration corresponds inversely to the peak voltage i.e. breakdown point of the solution plasma process. Furthermore, this study has also shown that magnetic properties could be observed within iron-gold (Fe_3O_4-Au) nanoparticles produced through the solution plasma process. However, the manipulated variables did not have a drastic effect on the observed magnetic properties of the nanoparticles.

The synthesized Fe_3O_4-Au core-shell nanoparticles have the potential applications for biomedical usage, such as magnetic resonance imaging, photothermal therapy, controlled drug delivery, protein separation, biosensors, DNA detection, and immunosensors. Moreover, referring to multifunctional nanoparticles designed for targeted drug delivery and release as 'smart bombs', by further coating the iron-gold nanoparticle along with the desired drug cargo with a selective surface coating which attaches to a specific cell type, e.g. cancer cells and disintegrates, drug-delivery technology could be enhanced.

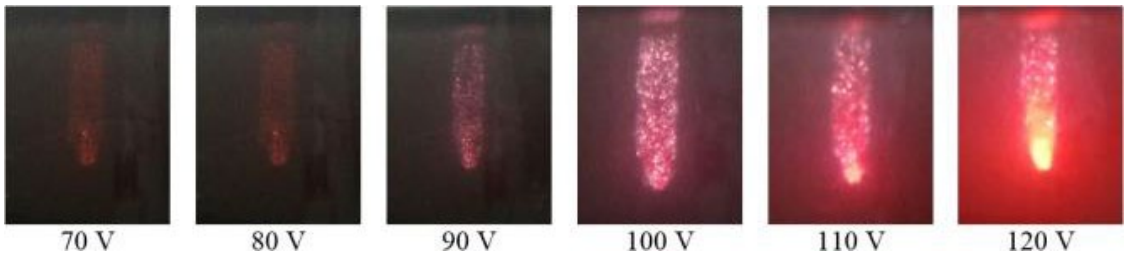

Figure 1: Plasma discharge intensities for iron nanoparticles synthesis.

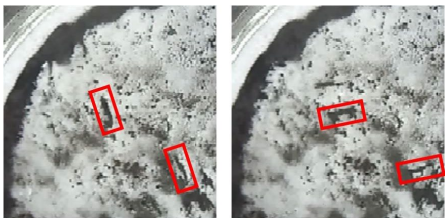

Figure 2: The self-orientation of the Fe_3O_4-Au core-shell nanoparticles under rotating magnetic field.