Immobilization of Biomolecules onto Magnetic Nanoparticles Functionalized by RF Plasma and Its Medical Application

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Magnetic nanoparticles have many great interests in potential to biomedical application such as high-sensitive virus detection, drug delivery system, hyperthermia treatments, magnetic resonance imaging contrast enhancement, etc [1]. Carbon coating of the magnetic nanoparticles can leave the toxicity out without detracting their magnetic properties and stabilize the nanoparticles so that compatible to be used in bioapplications. Among various functional groups for medical application, the introduction of amino groups composed of primary amines to the particles surface achieves enhanced wettability and improves its adhesion. However, this modification has not been deeply studied on carbon encapsulated magnetic nanoparticles. In fact very few information can be found on the topic of graphene layer-encapsulated iron nanoparticles related to the plasma surface treatment in order to introduce nitrogen-containing group functionalities, such as amino group.

In this study, we functionalize the graphene layer-encapsulated magnetic nanoparticles fabricated by dc arc discharge[2] by using Ar and NH_3 inductively-coupled RF plasmas[3]. After plasma treatment, the biomolecules are immobilized to the particles to test the role of the nitrogen-containing group as a linker to the biomolecules. The schematic sequence of the experimental steps is illustrated in Fig. 1. The amino functional groups produced in the second step are expected to serve as an anchor for covalent bonding with aldehyde groups of oxidized dextran. This step is followed by chemical derivatization method using 4-(trifluoromethyl)-benzaldehyde ($C_8H_5F_3O$) to determine the amount of free amino groups on the surfaces. For comprehensive discussion, X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and high resolution-transmission electron microscopy (HR-TEM) are used to characterize and analyze the results. These experimental results are presented and discussed at the conference.

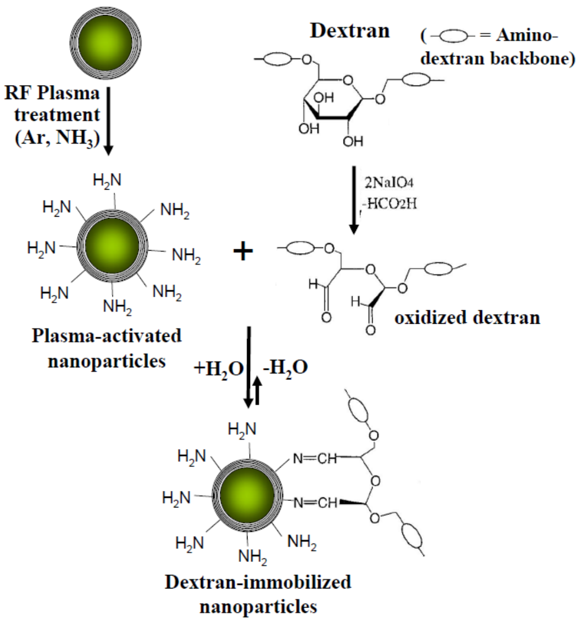

Figure 1: *Schematic illustration of plasma surface modification of nanoparticles.*

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