



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Nanotheranostic, a combination of diagnostic and therapeutic modalities at a nanoscale range offers a promising prospect in cancer therapeutics. Besides having the edges offered by the nanomaterials, it further refutes the need of separate units for individual modalities. The current thesis work is to develop novel nanoscale theranostic materials as potential candidates for their further clinical translation. The thesis is organised in six chapters. The first Chapter (Chapter 1) provides a holistic but comprehensive description about the need and basics of theranostics and current state of cancer theranostics. It also provides a comprehensive introduction of nanoclusters as majority of theranostic developed here are nanocluster based. The chapter also provides the background and objectives of the thesis. Chapter 2 describes the development of DNA (plasmid DNA) based smart theranostics for cancer therapy. The chapter entails the development of the DNA templated Au NCs and their further use in conjugation with cisplatin (anti-cancer drug) for developing composite NPs. Further these composite NPs were thoroughly characterized with various analytical instruments. The composite NPs were stable and had bright fluorescent with decent quantum yield. The composite NPs were readily taken up the HeLa cells and inflicted augmented cytotoxicity on the host cells while bioimaging them simultaneously. The composite NPs also have on demand loading capacity and pH dependent release profile. Chapter 3 deals with the synthesis of fluorescent gold nanocluster on dGTP, a small molecule. It should be borne here that whereas the previous work has gold nanocluster templated on DNA (have myriad of bases in it), this work is about stabilizing the gold nanocluster on a nucleotides (dGTP) rather the polymer of it. The dGTP templated Au NCs displayed impressive physical characteristics deemed of an imaging moiety and was further interacted with cisplatin to form theranostic composite NPs, which were further coated with PEG to provide a space for surface functionalization. The composite NPs were successful in the

shuttling the drug efficiently into the treated cells while concurrently bioimaging it. Chapter 4 describes the development of a single unit theranostic. Here MTX (methotrexate), a commercial clinical drug is used as a template to synthesise gold nanoclusters. These single unit theranostics were extremely stable both in PBS and blood serum. They were brightly fluorescent, photostable and were efficiently taken by the cells. They inflicted highly augmented cytotoxicity on the host cells, also enabling the concurrent bioimaging the host cells. Chapter 5 entails the formation of a folic acid conjugated chitosan NP on which these MTX NCs were loaded. The purpose of the chapter is to study the feasibility of replacing the free drug with MTX NCs which have higher cytotoxicity and additional fluorescent properties in a drug delivery vehicle. The NPs were efficiently taken up by the cells and bioimaged it. The host cells also displayed an almost two-fold reduction in IC₅₀ value of the drug when subjected to NPs in MTX NCs form. This augurs well for the further development of such single unit theranostics. Chapter 6 provides a comprehensive summary of the thesis and provides insight into the potential prospects of the thesis work.

