



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

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Programme of Study : Ph.D.

Thesis Title: Luminescent Composites of Hydroxyapatite Nanoparticles for Theranostic Applications

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**SHORT ABSTRACT**

The current thesis mainly focuses on a bioinspired inorganic source such as hydroxyapatite, whose composition resembles to that of human hard tissues, and its development into drug delivery nanocarriers. **Chapter 1** is the introduction section of the thesis, which focuses on the progressive advancement of nanotechnology through the development of various multifunctional nanocarriers in the recent past. The chapter discusses widely on the antibacterial and theranostic characteristics exhibited by various drug delivery nanosystems. **Chapter 2** emphasizes on the synthesis and characterisations of hydroxyapatite nanoparticles, doped with copper nanoclusters. They were further loaded with antibacterial drug namely kanamycin for applying towards antibacterial and antibiofilm applications. The nanoformulation loaded with kanamycin were found to be active against Gram negative bacteria and effective in eradication of biofilms formed by *Pseudomonas aeruginosa*. **Chapter 3** presents studies on copper nanocluster doped hydroxyapatite nanoparticles for cancer theranostics. An anticancer flavonoid drug namely quercetin, was loaded into copper nanocluster doped hydroxyapatite nanoparticles and analysed for anti-cell proliferative effects on monolayer culture and tumor spheroids of HeLa cells (cancer cells). The quercetin loaded nanocarrier triggered formation of reactive oxygen species, disrupted the cell cycle pattern with concomitant induction of apoptosis mediated cell death in treated cancer cells. The drug loaded copper nanocluster doped hydroxyapatite nanoparticles were effective in disrupting and inhibiting the proliferation of tumour spheroids, by releasing the loaded anticancer drug towards their interior. Additionally, the luminescence property inherited through copper nanoclusters enabled intracellular tracking of nanocarrier distribution, suggesting potential use of the present nanocarrier in cancer cell imaging. **Chapter 4** highlights on the combinatorial therapeutic effect implemented through copper nanocluster doped hydroxyapatite nanoparticles through co-delivery approach. The nanoformulation was encapsulated with norfloxacin (NX) and a photosensitizer methylene blue (MB). The nanocarrier carrying two therapeutic molecules was evaluated for combined therapy, conjugating chemotherapy and photodynamic therapy (PDT) on bacteria and cancer cells. In terms of application, combined therapy effectively reduced the colonies of Gram negative bacteria in comparison to individual treatments and reduced cell viability of HeLa and MCF-7 (cancer cells) significantly at lower doses of drug and photosensitizer. **Chapter 5** summarizes the major objectives and essential findings reported in the current dissertation. The promising possibilities of hydroxyapatite based nanoparticles as therapeutic and imaging entity have been discussed. The future prospects of the present drug delivery system include monitoring treatment of implant related infections, active targeting for specified therapy, tissue engineering applications and *in vivo* studies.