INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.

Thesis Title: **Bioinspired Engineering of Nanomaterials for Electrocatalytic Sensing of Heavy Metals and Organic Analytes**

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SHORT ABSTRACT

This work focuses on the bioinspired synthesis of various spherical and tailor-made nanoparticles using reducing and capping agents present in the leaves extract of the *Psidium guajava* (guava) plant. These bioinspired synthesized nanoparticles were used in the modification of graphite paste electrodes (GPEs) and glassy carbon electrodes (GCEs) by drop-casting method for electrochemical sensing of different organic analytes like ascorbic acid, dipyrone (drug), chlorpyrifos (organophosphate pesticide), and inorganic analytes (heavy metal ions). The mass spectra analysis of the bio-extract revealed the presence of various antioxidants and polyphenols like ascorbic acid, quercetin, chlorogenic acid, caffeic acid, naringenin, and rutin. These components could successfully reduce metal precursors like silver nitrate and chloroplatinic acid to produce stable silver, platinum, and tailor-made bimetallic core-shell Ag@Pt nanoparticles. The biomass residue generated during bio-extract preparation was also used to synthesize carbon dots for electrocatalytic sensing of chlorpyrifos.

The fabrication of a miniaturized three-electrode system was also successful for the electrochemical sensing of heavy metal ions. A portable electrochemical sensing device that can be applied for on-field monitoring of heavy metal ions was successfully developed using a fluorine-doped tin oxide based three-electrode system. Silver-coated copper nanorods (Cu@Ag) synthesized in an environmentally friendly method showed improved sensing capabilities than copper nanorods modified FTOs. Cu@AgNR/FTOs could successfully quantify Pb(II), Zn(II), Cd(II), and Hg(II) both in single metal systems and in mixed metal matrices with the detection limits in the nanomolar range. The device showed repeatability of up to 4 cycles, thus providing an alternative to the conventional screen-printed electrodes that are typically single-use devices and generate a lot of plastic wastes.