



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Simpler Bio-based Synthesis of Nanoparticles for Heavy Metal Optical Sensing Applications

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SHORT ABSTRACT

The demand for clean drinking water is ever increasing in India due to its large population (1.3 billion people). Limited availability of clean drinking water and increased emphasis on various anthropogenic and natural processes has led to increased ecological risks. According to a study conducted by the Ministry of Water Resource, India, 57 stations out of 414 stations at important river basins contain toxic metals beyond the permissible limit. Water in such resources are considered to be unfit for drinking purposes. Therefore, it is high time to develop a low-cost and affordable heavy metal sensing technique that can be deployed directly for the monitoring of the water quality.

Till date, several conventional techniques such as AAS, ICP-MS, chromatography, etc. are commonly utilized to detect heavy metals in aqueous media. These are well-known to have certain disadvantages such as costly instrumentation, maintenance requirements, utilization of hazardous reagents, time-consuming procedures and limited in-situ capability. Hence, there is a need to develop straightforward, budget-friendly, on-site analytical approach for the detection of trace heavy metals in aqueous systems. For this purpose, colorimetric and fluorescence techniques utilizing metal nanoparticles as optical sensors are highly appealing due to their cost-effectiveness, simplicity, selectivity, speed of detection and ease of use. However, for the synthesis of these nanoparticles, research emphasis shall be upon novel and sustainable approaches such as bio-based synthesis.

A primary challenge for bio-based synthesis metal nanoparticles is in terms of the utilization of inexpensive, waste biomass to thereby obtain a stable, uniform nanoparticles system at ambient processing temperature within short period of time. Further, simpler synthesis procedures shall be developed using which stable nanoparticle systems can be obtained. Many plant organs have abundant constitution of phytochemicals such as polyphenols, flavonoids, ascorbic acid and other enzymes that assist in the reduction and stabilization of metal ions to achieve the corresponding nanoparticle system. These shall be explored for effective nanoparticle synthesis.

Considering the limitations in the prior art, the Ph.D. thesis research work devotes to the synthesis and application of stable and uniform metal nanoparticles under ambient temperature using mature green tea leaves (*Camellia*

Sinensis) as a source of reducing and stabilizing agents. Mature green tea leaves are promising due to their features such as non-expensive status, waste product of not much commercial relevance and production in all seasons in regions such as the North-east India. As such, they are rich in polyphenolic compounds such as flavonoids. With powerful reducing properties, polyphenols impart higher stability to the synthesized nanoparticles. The primary objective of the thesis is upon the bio-based synthesis of metal nanoparticles utilizing mature green tea leaves and their application as an optical sensor to detect toxic heavy metals in aqueous solutions. For this purpose, synthesis parameters such as pH, bio-extract and precursor concentration were optimized and simple differential centrifugation technique was utilized to obtain stable and monodispersed nanoparticles.

