



### Industrial Consultancy & Sponsored Research (IC&SR)

#### A LUMINESCENCE-BASED METHOD OF DETECTING ARSENIC USING ATOMICALLY PRECISE NOBLE METAL NANOCLUSTER AND PHOSPHINE

**IITM Technology Available for Licensing**

#### PROBLEM STATEMENT

- **Arsenic**, the 20th abundant element, poses a global health threat due to its widespread distribution and increasing anthropogenic activities.
- **Conventional methods like AAS, ICP-MS, AFS, ICP-OES, and GFAAS** are used to determine arsenic in water, soil, and food samples.
- These methods have limitations like **heavy instruments**, limited applicability, and the need for skilled personnel.
- **Field test kits provide a cost-effective**, semi-quantitative method for measuring arsenic contaminated water.
- **Nanoparticle detection methods** include colorimetry, fluorescence, and electrochemistry.
- **Sensitive gold nanoparticle (AuNP)-based assays and aptamer-conjugated AgNPs** are used for colorimetric sensing of As(III) ions.

#### TECHNOLOGY CATEGORY MARKET

**Technology:** Phosphine aided arsenic detection using luminescent atomically precise noble metal nanocluster

**Category:** Micro & Nano Technologies

**Industry:** Material Science /Chemical

**Application:** Detecting arsenic

**Market:** The global market size reached a valuation of **USD 29 Billion in 2023**, with projections to achieve **USD 53.5 Billion by 2031**, a compound annual growth rate (CAGR) of **9.14% from 2024 to 2031**.

#### INTELLECTUAL PROPERTY

IITM IDF Ref. 2179,  
Patent No: IN 484286

#### TRL (Technology Readiness Level)

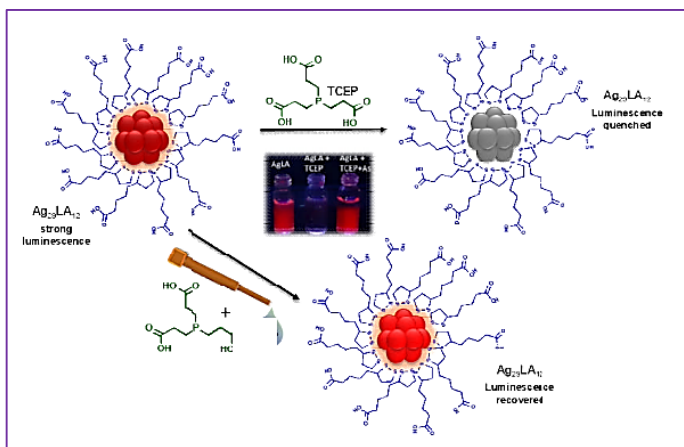
TRL- 4, Experimentally validated in Lab;

#### Research Lab

Prof. Pradeep T, Dept. of Chemistry

#### TECHNOLOGY

The below fig shows a schematic representation of luminescence-based As detection using red 30 luminescent Ag<sub>29</sub>LA<sub>12</sub> nanocluster and TC



1

•A luminescence-based method for detecting arsenic, the said method involves

2

•Adding 50 µl of 10.8 mM an external phosphine reagent in 1.85 ml of arsenic containing solution;

3

•Adding 100 µl of atomically precise luminescent metal nanocluster protected by a water soluble ligand, Ag<sub>29</sub>LA<sub>12</sub> nanocluster to the mixture obtained from step (i);

4

•Detecting the luminescence of the Ag<sub>29</sub>LA<sub>12</sub> nanocluster from the resultant mixture;

5

•Characterized In That, Addition Of An External Phosphine Reagent Results In Quenching Of The Nanocluster Luminescence, While, The Presence Of As(iii/v) Ions In The Nanocluster-phosphine Medium Leads To Restoration Of The Luminescence Of Ag<sub>29</sub>LA<sub>12</sub> Nanocluster Due To Preferential Interaction Of Phosphine Reagent With Arsenic Ions

#### CONTACT US

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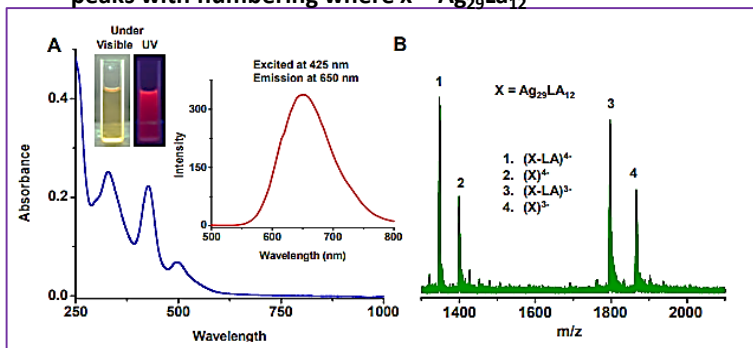
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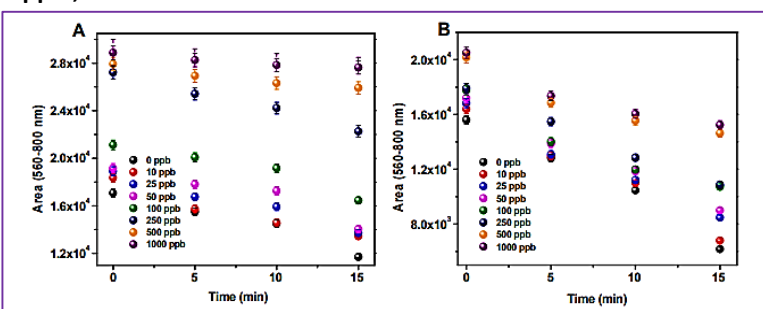
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The below graph shows a Characterization of  $Ag_{29}La_{12}$  NC.

- (A) absorption and emission spectra of NC, with its optical image under visible and UV light (inset).  
(B) ESI MS of the cluster sample showing assignment of the peaks with numbering where  $x = Ag_{29}La_{12}$

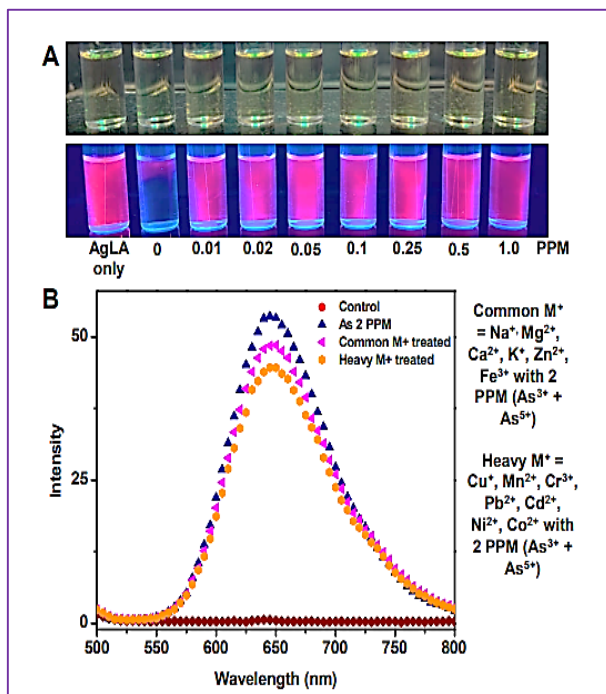


The below fig depicts a kinetics of luminescence recovery due to (A) As(III) and (B) As(V) for a 15 concentration range of 0 to 1 ppm, measured from 0 to 15 min of their interaction with NC-CEP



The below fig shows

- (A) optical images showing NC alone (left most), NC+TCEP tested with various concentrations of As ranging from 0 to 1 ppm, under visible and UV light, and (B) NC-TCEP system tested for luminescence recovery due to As after masking various interfering common cations and heavy metals in water



### Key Features / Value Proposition

#### Nanocluster Restoration Method

Silver nanocluster protected by water-soluble lipionic acid ligand.

$Ag_{29}La_{12}$  nanocluster emits red luminescence at 650 nm.

External phosphine reagent: tris-20 tricarboxy ethyl phosphine reagent.

$Ag_{29}La_{12}$  nanocluster loses red luminescence when exposed to external phosphine via electron transfer.

$Ag_{29}La_{12}$  nanocluster restores red luminescence when exposed to arsenic phosphine.

Restoration is directly proportional to arsenic concentration in solution.

Restoration occurs when other common and heavy metal ions are masked/scavenged.

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