AMBIENT MICRODROPLET ANNEALING METHOD FOR CONVERTING POLYDISPERSED NANOPARTICLES TO THEIR MONODISPERSED ANALOGUES

IITM Technology Available for Licensing

Problem Statement

- **Conventional methods for polydispersed nanoparticle** conversion and superstructure formation are slow and complex, requiring added chemicals and precise control.
- **Need for a rapid, simple approach for monodispersed nanoparticles** and spontaneous self-assembly **without additional chemicals or temperature control.**
- The invention uses **ambient electrospray** to transform nanoparticles and self-assemble into organized films within seconds.
- This method offers **efficiency, simplicity, and scalability** for large-scale production of uniform nanoparticles and advanced materials.
- The technique opens opportunities in **nanotechnology, electronics, and materials science applications.**

Technology Category/ Market

Category – Nanotechnology, Materials Science

Applications - Nanoparticle-based electronics and sensors, Drug delivery systems, Catalysis and energy storage, Biomedical imaging and diagnostics, Nanocomposites and advanced materials.

Industry - Pharmaceutical and healthcare Electronics and semiconductor, Energy and renewable energy, Chemical and catalysis, Aerospace and defense, Coatings and materials manufacturing, Nanotechnology research and development.

Market -Nanotechnology Market size was valued at USD 10.63 Billion in 2022 and is projected to reach USD 31.40 Billion by 2030, growing at a **CAGR of 14.5% from 2023 to 2030.**

Intellectual Property

- **IITM IDF Ref.2125**
- **IN 377934 (PATENT GRANTED)**

TRL (Technology Readiness Level)

TRL- 3/4, Proof is ready, and concept is validated in lab.

Key Features / Value Proposition

Technical Perspective:

- **Easy and rapid electrospray method** for converting polydispersed nanoparticles to monodispersed analogues and **forming superlattice nanostructures.**

Industrial Perspective:

- Enables **efficient production of monodispersed nanoparticles** and organized nanocrystal assemblies, with potential applications in various industries, such as **electronics, catalysis, and energy storage.**

Technology

- The invention utilizes an **ambient electrospray method** for **polydispersed nanoparticle** transformation into their **monodispersed analogues** within matter of seconds.
- The process does not require the addition of **extra chemicals, templates, or temperature control.**
- With this innovative technique, nanoparticle self-assembly occurs spontaneously, **forming well-organized films** without the need for external influences or complicated post-synthetic modifications..
- The method allows precise control of the nanoparticle size achieved, with demonstrated transformation of **15 ± 10 nm to 4.0 ± 0.5 nm silver nanoparticles.**
- A **home-made and simple nanoelectrospray** set-up produced charged microdroplets for the generation of such nanostructures, forming **cm2 areas of uniform nanoparticles.**
- A free-standing thin film of monodispersed silver nanoparticles was also made on a **liquid surface by controlling the electrospray conditions.**
- This unique method may be extended for the **creation of advanced materials** of many kinds.

Research Lab

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Image

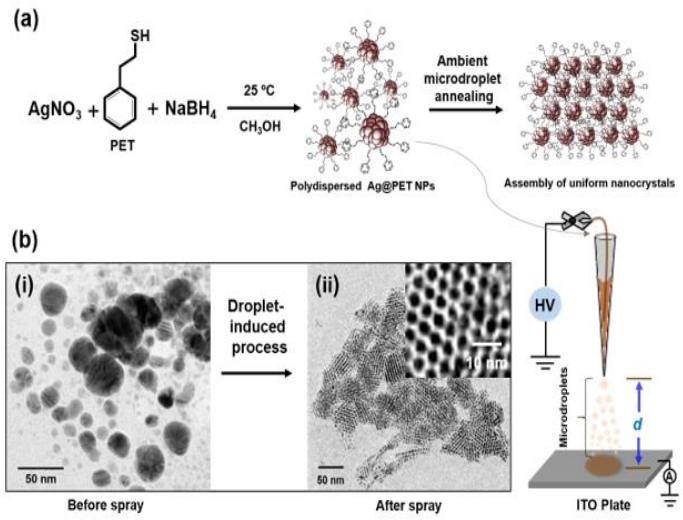

Fig 1. Synthetic route: AgNO3 + NaBH4 reduction of Ag ions in PET microdroplets; Conversion to monodispersed analogues via ambient microdroplet annealing.

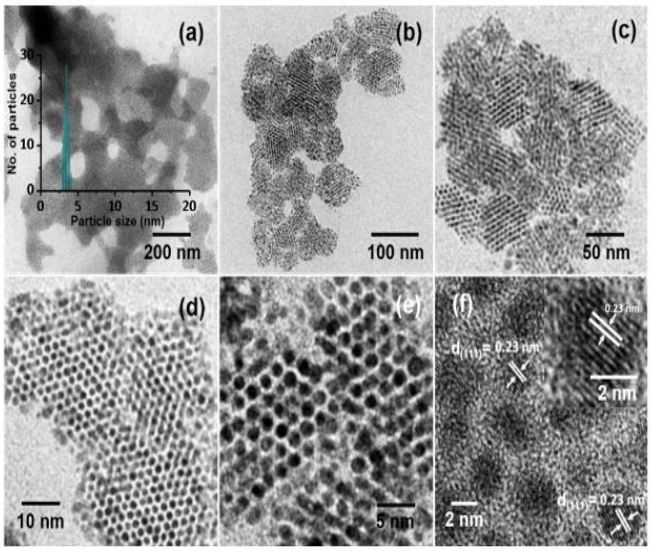

Fig 2. HRTEM images of crystalline Ag@PET NPs after optimized electrospray reveal 2D sheet-like morphology, superlattice assembly, uniform inter-particle distance, and (111) lattice plane.

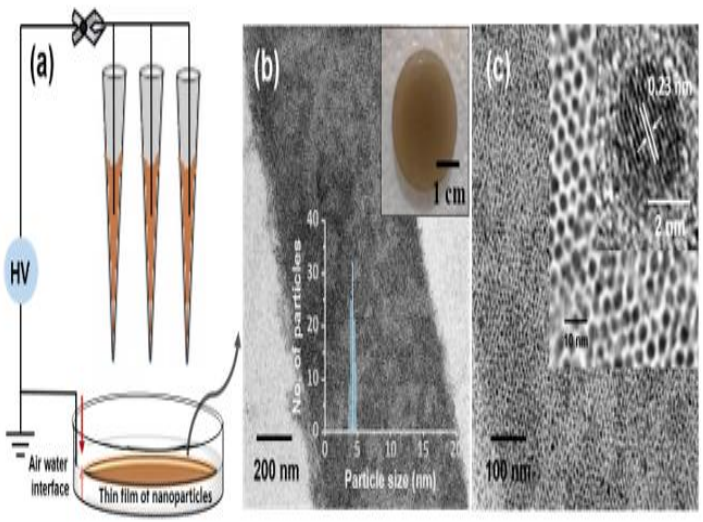

Fig 3. Schematic illustration of electrospray deposition of Ag@PET NPs on a water surface, resulting in a monolayer film of ordered Ag@PET NP crystals with confirmed metallic Ag formation.

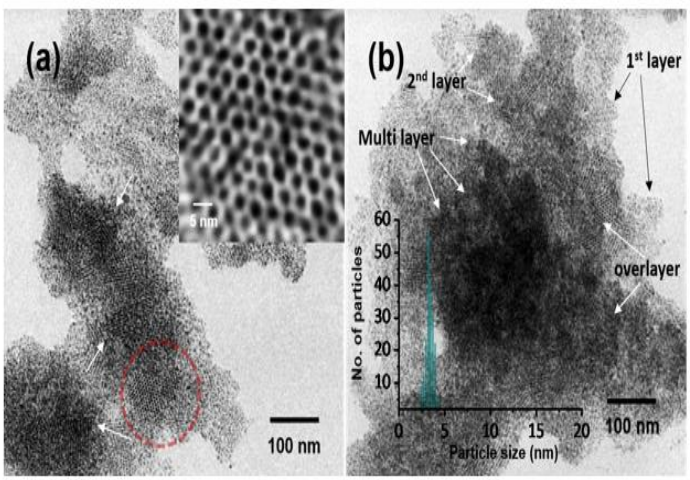

Fig 4. Formation of 3D ordered monodispersed assemblies of AgNPs through electrospray for an extended period, showing the deposition of layers of NPs and the genesis of second layer superlattices.

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