IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO - IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

Drug Loading In Nanomaterials Using Microgravity

IITM Technology Available for Licensing

PROBLEM STATEMENT

- **Nanotechnology** has made significant advancements in nanomedicine, enhancing drug bioavailability, pharmacokinetics, and targeted delivery.
- **Nanomedicine** is used for diagnosis, monitoring, control, prevention, and treatment of diseases, and regenerative medicine.
- **Nanomaterials like liposomes** can enhance drug solubility and focus on specific disease sites. However, current nanomedicines have limited drug loading efficiency, typically below 10%.
- Research has attempted to improve **drug loading efficiency** in nanomaterials, but this has been challenging, expensive, time-consuming, and requires specialized expertise.
- A universal framework is needed to optimize drug loading efficiency across all types of nanomaterials.

TECHNOLOGY CATEGORY/ MARKET

Technology: Drug Loading In Nanomaterials Using Microgravity
Category: Medical & Surgical Devices, Micro & Nano Technologies
Industry: Medical & Surgical, Space Technology
Application: Nano formulation in medical field
Market: The global market size of microgravity research was estimated to be **USD 3.5 billion** in 2023 and is projected to reach approximately **USD 8.4 billion by 2032**, growing at a compound annual growth rate (CAGR) of 10.2% during the forecast period

INTELLECTUAL PROPERTY

IITM IDF Ref. - 2819
Patent No: IN – 562410 (Granted)

TRL (Technology Readiness Level)

TRL 3, Experimental proof of concept

Research Lab

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Biomedical Engineering, IIT Madras.

TECHNOLOGY

Microgravity-based Drug Loading Method

- Utilizes microgravity conditions, typically achieved using equipment like RPM, Clinostat, or Rotating Wall Vessel.
- Reduces gravitational force to 10^-3 to 10^-4 times standard gravity, minimizing particle agglomeration.
- Enhances mixing and distribution of drugs within nanomaterials, improving loading efficiency.
- Optimizes drug-nanomaterial interaction, potentially leading to higher drug encapsulation or adsorption onto nanocarriers.

Nanomaterials and Drug Types

- Applicable to various nanomaterials like IONP, liposomes, polymer nanoparticles, and MOFs.
- Drug types loaded include anticancer drugs(eg. Cisplatin), proteins, peptides, nucleic acids, vitamins, and other therapeutic agents.
- Supports loading multiple drug types onto the same nanomaterial platform.

Process and Efficiency

- The drug and nanomaterial mixture undergoes microgravity exposure for 6-18 hours, improving efficiency by 2-4 times compared to standard gravity or shaking.
- The nanomaterials maintain therapeutic effects and exhibit similar drug release profiles.

Characterization and Evaluation

- The technology utilizes common characterization techniques like UV-Vis spectrophotometry, SEM (Scanning Electron Microscopy), XRD (X-ray Diffraction), and FTIR (Fourier Transform Infrared Spectroscopy) to confirm the quality, size, morphology, and loading efficiency of the nanomaterials.

CONTACT US

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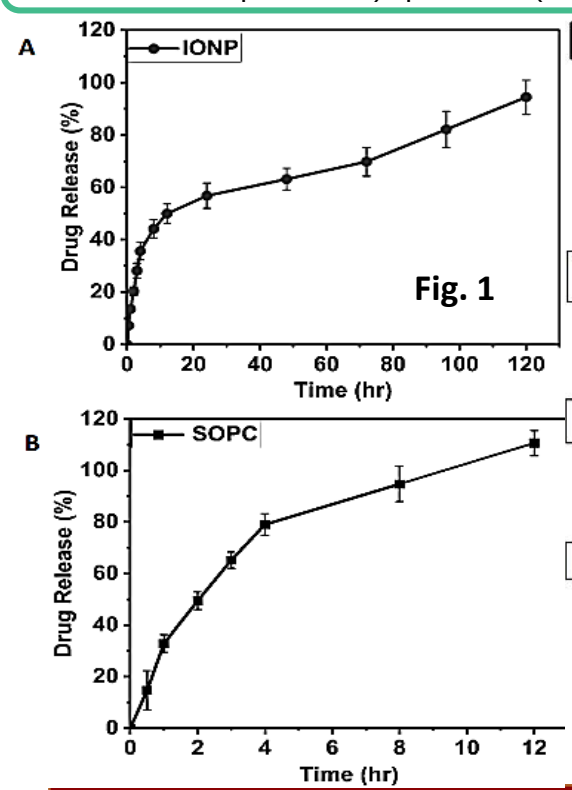
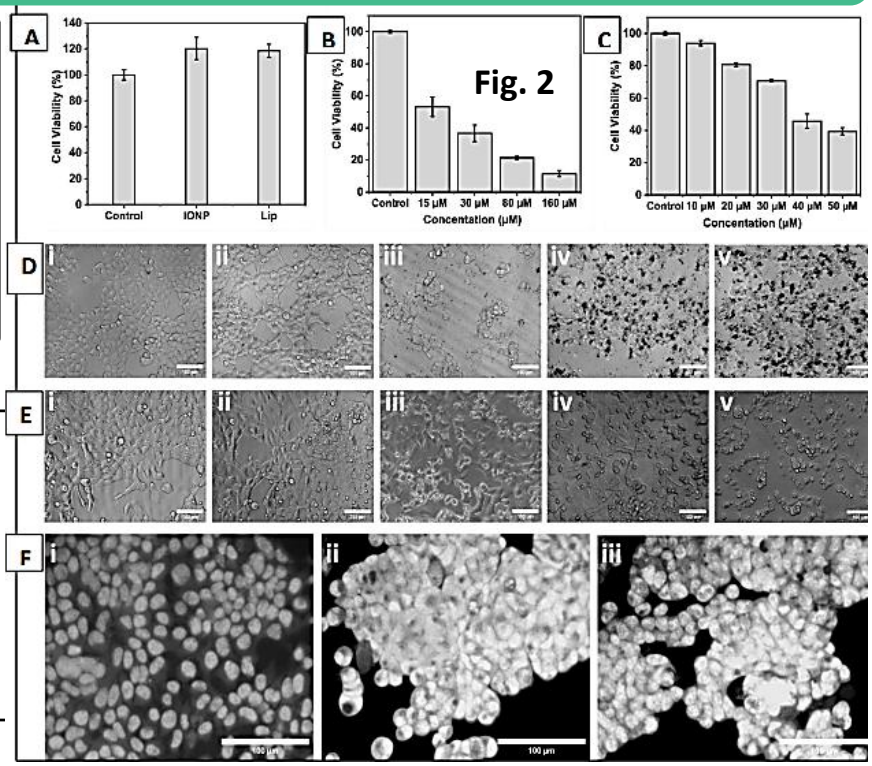
Fig. 1 illustrates cumulative drug release kinetics of **(A) Cisplatin loaded IONP** and **(B) Cisplatin loaded liposomes. Fig. 2** illustrates **a)** MTT assay confirming the biocompatibility of IONP and SOPC; cytotoxicity assays for **b)** Cis-IONP and **c)** Cis-Lip; microscopic images representing the cellular images at various concentrations of **d)** i-Control, ii-v different concentrations of Cis-IONP and **e)** i-v different concentrations of Cis-Lip; **f)** Live/dead assays fluorescence microscopic images of i) control (untreated), ii) Cis-IONP at 160µM, and iii) liposomes (Cis-Lip) at 50µM





Key Features / Value Proposition

Increased Drug Loading Efficiency

Requires lower drug doses, reducing side effects and costs.

Therapeutic Consistency & Safety

Maintains similar drug release and cytotoxicity to traditional methods.

Enhanced Drug-Carrier Interaction

Stronger drug-nanomaterial interactions for better encapsulation.

Potential in Cancer Therapy

Enables targeted drug delivery to tumors, improving efficacy and reducing side effects.

Improved Homogeneity & Distribution

Uniform drug loading with better release profiles.

Cost & Resource Efficiency

Streamlines the drug loading process, reducing labor and costs.

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