Firm name: Bubbles & Café Inc.

Project title: Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Growth in Microgravity.

Part 1: Table of Contents

Part 2: Identification and Significance of the Opportunity.

The proposed innovation: Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Growth in Microgravity.

Overview: The proposed project aims to revolutionize nanocrystal synthesis by harnessing the power of spintronics, spin-based quantum sensors, and fluid dynamics optimization in a microgravity environment. This innovative approach seeks to achieve precise control over nanocrystal properties, including size, shape, composition, and crystallinity, under the unique conditions of microgravity. By integrating cutting-edge technology and advanced control strategies, this project has the potential to unlock new possibilities for materials science and various high-tech applications.

Key Objectives:

Nanocrystal Synthesis in Microgravity: The project's central goal is to conduct nanocrystal synthesis experiments in a microgravity environment. Microgravity offers a controlled setting where fluid dynamics behave differently, allowing researchers to explore novel strategies for nanocrystal growth.

Spintronics and Quantum Sensors: The project will leverage state-of-the-art spintronics and spin-based quantum sensors to monitor and control the behavior of nanoparticles and molecules involved in nanocrystal synthesis. These sensors will provide real-time data on spin properties, enabling precise manipulation of reactants.

Fluid Dynamics Optimization: Advanced fluid dynamics optimization techniques will be employed to ensure uniform mixing, temperature control, and turbulence management within the reaction vessel. This optimization is crucial for achieving reproducible and high-quality nanocrystal properties.

Real-Time Feedback Control: The integration of spin-based sensors and fluid dynamics optimization will enable the development of a closed-loop feedback control system. This system will continuously adapt external parameters such as magnetic field strength, temperature gradients, and reactant flow rates to maintain desired fluid dynamics and optimize nanocrystal growth.

Customized Spin Labels: Specialized spin labels will be developed to attach to specific molecules or nanoparticles, allowing for targeted manipulation of reactants. These labels may respond to external stimuli, further enhancing control over the synthesis process.

Multimodal Monitoring: The project will explore the integration of spin-based sensors with other sensing modalities, such as imaging techniques, to provide a comprehensive view of fluid dynamics and nanocrystal growth.

Expected Outcomes: Enhanced nanocrystal control for various applications; Improved reproducibility in synthesis; Microgravity study on nanocrystal growth; Potential quantum algorithm breakthroughs; Spintronics and quantum

sensors for precise control; Real-time spin data during synthesis; Deeper quantum behavior understanding; Advancing technology for wider use.

The proposed innovation's **relevance and significance** in the context of the problem statement and background are evident for several reasons:

In-Space Manufacturing in LEO: Addresses NASA's need for in-space manufacturing, specifically in Low Earth Orbit (LEO), supporting semiconductor and biomedical device production.

Microgravity Benefits: Capitalizes on microgravity's advantages for superior nanocrystal growth, minimizing convection, buoyancy, and sedimentation for higher-quality materials.

Alignment with CHIPS Act: Aligns with the CHIPS Act's focus on semiconductor advancement, contributing to the competitiveness of semiconductor manufacturing.

Multidisciplinary Approach: Integrates Spintronics, Spin-Based Quantum Sensors, and fluid dynamics, offering multidisciplinary breakthroughs in materials science, sensor technology, and fluid control.

Enhancing Analytical Tools: Facilitates the development of in-situ monitoring and analytical tools for real-time data on crystal growth and quality.

Economic and Technological Advantages: Supports cost-effective space-based manufacturing, reducing launch costs and fostering technological progress.

The proposed innovation in nanocrystal growth in microgravity offers several key **advancements compared to the current state of the art**:

Integration of Cutting-Edge Technologies: Combines Spintronics and Spin-Based Quantum Sensors, offering a holistic approach that hasn't been widely explored in microgravity nanocrystal growth.

Precise Growth Control: Provides real-time, precise control and monitoring of crystal growth, surpassing empirical methods and leading to higher quality nanocrystals.

Improved Fluid Dynamics Understanding: Utilizes fluid dynamics principles and modeling to better control reactant and solvent flow, enhancing predictability in crystal growth.

Microgravity Adaptation of Technologies: Pushes the boundaries of Spintronics and Quantum Sensors for space use, harnessing their precision and sensitivity.

Advances Space-Based Manufacturing: Elevates space-based manufacturing capabilities, enabling the production of advanced materials with superior properties.

Relevance to Emerging Space Industries: Addresses the needs of emerging space industries, offering a competitive edge by producing optimized materials for space applications.

Part 3: Technical Objectives

The **Phase I R&D objectives** for "Leveraging Spintronics, Spin-Based Quantum Sensors, and optimizing fluid dynamics for Enhanced Nanocrystal Growth in Microgravity" within "Closing Capability Gaps to Accelerate In-Space Production Applications in LEO" are as follows:

Optimize Fluid Dynamics: Enhance nanocrystal growth by optimizing fluid dynamics in a microgravity environment, including control of fluid flow, temperature gradients, and mass transfer processes.(Phase I)

Integrate Spintronics: Explore Spintronics and Spin-Based Quantum Sensors to manipulate and monitor fluid behavior within the reaction vessel for improved nanocrystal quality.(Phase II)

Achieve Desired Nanocrystal Properties: Produce nanocrystals with superior uniformity, structural quality, and size compared to Earth-based methods, leveraging microgravity advantages.(Phase I & II)

Assess Feasibility: Evaluate the practicality of implementing proposed techniques in LEO for in-space nanocrystal synthesis.(Phase II)

Ensure Safety and Reliability: Address safety and reliability concerns related to space operations with advanced technologies.(Phase II)

Evaluate Cost-Effectiveness: Assess cost-effectiveness and scalability for commercial in-space manufacturing, considering integration into broader LEO manufacturing processes.(Phase II)

Document and Report Findings: Create comprehensive documentation of research, methodologies, and results for Phase II and future development efforts. Include reports on fluid dynamics optimization, Spintronics utilization, and nanocrystal growth achievements.(Phase I & II)

At the end of the 6-month Phase I effort for "Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Crystal Growth in Microgravity," the **proposed deliverables** aligned with the topic of "Closing Capability Gaps to Accelerate In-Space Production Applications in LEO" are as follows:

Firm name: Bubbles & Café Inc.

Project title: Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Growth in Microgravity.

Experimental Setup: Design and develop an experimental setup for microgravity nanocrystal growth, equipped with hardware and instrumentation to control fluid dynamics, temperature, and relevant parameters within the reaction vessel.(Phase I)
Sensor Integration: Incorporate Spintronics and Spin-Based Quantum Sensors into the setup for real-time monitoring and control of fluid dynamics during nanocrystal growth.(Phase II)
Fluid Dynamics Algorithms: Create advanced algorithms to optimize fluid dynamics within the reaction vessel, utilizing sensor data to precisely control nanocrystal precursor movement for enhanced growth and uniformity.(Phase II)
Growth Protocols: Establish nanocrystal growth protocols tailored for microgravity conditions, leveraging reduced convection, buoyancy, and sedimentation to produce highly ordered, homogeneous nanocrystals with improved structural quality.(Phase I & II)
Data Analysis Tools: Develop in-situ monitoring and analysis tools, including microscopy, thermal analysis, and material response characterization, to assess nanocrystal quality and properties.(Phase I & II)
Preliminary Samples: Generate proof-of-concept nanocrystal samples showcasing the potential of Spintronics, Quantum Sensors, and optimized fluid dynamics to enhance microgravity nanocrystal growth. (Phase I & II)
Progress Report: Provide a comprehensive progress report detailing achievements, challenges, and lessons learned during Phase I.(Throughout)
Technical Documentation: Create technical documentation outlining the experimental setup, algorithms, and data analysis methods employed.(Throughout)
Feasibility Assessment: Evaluate the feasibility of scaling up the nanocrystal growth process for larger-scale production in future phases, considering potential applications in semiconductor and biomedical device manufacturing in LEO.(Phase II)
These deliverables collectively address the need for advanced materials research and development in microgravity, aligning with NASA's goal to support in-space production applications in LEO and enhance manufacturing capabilities for various industries.

Part 4: Work Plan

Phase I R&D Plan: Duration is only 6 months. I have included some details of Phase II for a complete picture of the project.

Objective: To achieve the technical objectives outlined in Phase I of the project.

1. **Optimization of Fluid Dynamics(Weeks 1 -32)(Phase I)**

What: Conduct a comprehensive study of fluid dynamics in microgravity environments, including the behavior of fluids within the reaction vessel. Explore methods to control fluid flow, temperature gradients, and mass transfer processes.
Where: Pritzker Nanofabrication Facility (PNF) and/or International Space Station (ISS). Computational fluid dynamics (CFD) simulations will be performed to model microgravity conditions.
How:
Design and fabricate a scaled-down model of the reaction vessel.(Phase I)
Implement CFD simulations to understand fluid behavior.(Phase I)
Conduct experiments in ISS to validate simulation results. (Tentative)
Iterate on vessel design and fluid control techniques based on findings. (Phase II)

2. **Integration of Spintronics and Spin-Based Quantum Sensors(Weeks 33-48) (Phase II)**

What: Investigate the application of Spintronics and Spin-Based Quantum Sensors to manipulate and monitor fluid dynamics within the reaction vessel.
Where: Pritzker Nanofabrication Facility (PNF)
How:
Research existing Spintronics and Spin-Based Quantum Sensors technologies.
Develop prototypes or adapt existing devices for controlling fluid dynamics.
Conduct experiments to assess the precision and accuracy of these technologies in controlling fluid behavior.

3. Achievement of Desired Nanocrystal Properties(Weeks 49-64)(Phase I & II)

What: Implement optimized fluid dynamics control techniques and Spintronics-based monitoring in nanocrystal growth experiments to produce nanocrystals with desired properties.
Where: Pritzker Nanofabrication Facility (PNF)
How:

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Set up nanocrystal growth experiments in microgravity simulators.
Apply the fluid control techniques developed.
Monitor and adjust fluid behavior in real-time using Spintronics-based sensors.
Analyze resulting nanocrystals for structural quality, uniformity, and size.

4. Feasibility Assessment(TBD)

What: Evaluate the feasibility of implementing the optimized techniques and Spintronics-based solutions in the actual microgravity environment of LEO.
Where: International Space Station (ISS)
How:
Prepare for microgravity experiments.
Execute experiments with a focus on safety and equipment reliability.
Compare results with simulations and laboratory experiments to assess practicality.

5. Safety and Reliability Assessment (TBD)

What: Address safety and reliability concerns associated with the use of advanced technologies in space.
Where: Laboratory settings and safety evaluations conducted on Earth.
How:
Conduct safety assessments of Spintronics and Spin-Based Quantum Sensors in microgravity environments.
Develop fail-safe mechanisms and protocols.
Ensure compliance with space operation standards and protocols.

6. Cost-Effectiveness and Scalability (TBD)

What: Evaluate the cost-effectiveness and scalability of the developed methods and technologies for commercial in-space manufacturing.
Where: Cost analysis conducted on Earth.
How:
Perform a cost analysis of the materials, equipment, and processes used in the project.
Assess the scalability of the methods for larger-scale manufacturing in LEO.

7. Documentation and Reporting (Throughout)

What: Produce comprehensive documentation of research findings, methodologies, and results.
Where: On Earth, within laboratory and office settings.
How:
Maintain detailed records of experiments, simulations, and safety assessments.
Generate comprehensive reports at regular intervals, summarizing progress and results.
Compile all documentation into a final report for Phase I.

Task Descriptions, Schedules, Resource Allocations, Estimated Task Hours, and Planned Accomplishments for Phase I R&D Plan: Duration is only 6 months. I have included some details of Phase II for a complete picture of the project.

Objective 1: Design and Development of the Reaction Vessel

Task 1.1: Setup of Nanocrystal Growth Experiments (Weeks 1-8)

Description: Prepare and set up nanocrystal growth experiments.
Schedule: Weeks 1-8.
Resource Allocation: Laboratory space, equipment, materials for nanocrystal synthesis, and PI.
Estimated Task Hours (PI): 320 hours.
Planned Accomplishments: Experiment setups ready; Preliminary experiments with nanocrystals and data collection; Identify and document preliminary optimized synthesis parameters for nanocrystal growth; Safety protocols and training.

Task 1.2: Comprehensive Study of Fluid Dynamics (Weeks 9-16)

Description: Conduct a literature review and preliminary simulations to understand fluid dynamics in microgravity.
Schedule: Weeks 9-16.
Resource Allocation: PI, access to research databases, and simulation software.
Estimated Task Hours (PI): 320 hours.
Planned Accomplishments: Literature review completed; Critical fluid dynamic parameters that are relevant to the nanocrystal growth experiments are identified; Initial simulations set up and running; Data collection and analysis.

Task 1.3: Design and Build the Reaction Vessel (Weeks 17-24)

Firm name: Bubbles & Café Inc.

Project title: Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Growth in Microgravity.

Description: Design and construct the specialized reaction vessel optimized for nanocrystal growth in microgravity.
Schedule: Weeks 17-24.
Resource Allocation: Laboratory space, materials for vessel construction, and PI.
Estimated Task Hours (PI): 320 hours.
Planned Accomplishments: Completed design of the reaction vessel; Completed construction of the initial version of the reaction vessel.

Task 1.4: Document and Report Findings(Throughout): Create comprehensive documentation of research, methodologies, and results for Phase II and future development efforts. Include reports on fluid dynamics optimization, Spintronics utilization, and nanocrystal growth achievements. Weeks 25-26 are used to finalize the documentation for Phase I progress report.

⭐**Milestone: Phase I proposal package including papers and articles on the innovation submitted to the scientific journals, detailed documentation of the experiments and results and findings, initial prototype of the reaction vessel will be submitted to NASA for evaluation of Phase I.**

Task 1.5: Iterative Design and Development (Weeks 30-37)(Phase II)

Description: Use data from experiments to refine the design of the reaction vessel and develop innovative fluid control techniques.
Schedule: Weeks 30-37.
Resource Allocation: Laboratory space, materials for vessel modification, and PI;
Estimated Task Hours (PI): 320 hours.
Planned Accomplishments: Improved vessel design; Prototypes of fluid control techniques.

Objective 2: Integration of Spintronics and Spin-Based Quantum Sensors

Task 2.1: Research and Adapt Existing Technologies (Weeks 38-45)(Phase II)

Description: Investigate available Spintronics and Spin-Based Quantum Sensors technologies. Adapt or develop prototypes for fluid control.
Schedule: Weeks 33-40.
Resource Allocation: PI, access to relevant technology databases, and materials for prototype development;
Estimated Task Hours (PI): 320 hours.
Planned Accomplishments: Identification of suitable technologies; Prototypes of adapted sensors.

Task 2.2: Experimentation with Sensors (Weeks 46-53)(Phase II)

Description: Conduct experiments to assess the precision and accuracy of sensors in controlling fluid behavior.
Schedule: Weeks 46-53.
Resource Allocation: Laboratory space, sensors, and PI; **Estimated Task Hours (PI):** 320 hours.
Planned Accomplishments: Data on sensor performance in fluid control.

Objective 3: Achievement of Desired Nanocrystal Properties

Task 3.1: Implementation of Fluid Control and Monitoring (Weeks 53-60)(Phase II)

Description: Apply the optimized fluid control techniques and Spintronics-based monitoring during nanocrystal growth experiments.
Schedule: Weeks 49-56.
Resource Allocation: Laboratory equipment, sensors, and PI; **Estimated Task Hours (PI):** 320 hours.
Planned Accomplishments: Controlled fluid dynamics during experiments; Developed algorithms for the closed-loop feedback control system.

Task 3.2: Analysis of Nanocrystals (Weeks 61-68)(Phase II)

Description: Analyze resulting nanocrystals for structural quality, uniformity, and size.
Schedule: Weeks 57-64.
Resource Allocation: Laboratory equipment, materials for analysis, and PI; **Estimated Task Hours (PI):** 320 hours.
Planned Accomplishments:
Assessment of nanocrystal properties.

Objective 4: Microgravity Experiment Validation

Task 4.1: Feasibility Study and Reaction Vessel Testing on the ISS (TBD)(Phase II)

Description: Conduct a comprehensive feasibility study and validate the performance of the specialized reaction vessel designed for nanocrystal growth in microgravity conditions on the International Space Station (ISS). Alternatively, microgravity simulation facilities could be used; **Schedule:** TBD.

Firm name: Bubbles & Café Inc.

Project title: Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Growth in Microgravity.

Resource Allocation: Access to the ISS or any microgravity simulation facility, scientific equipment, materials for nanocrystal synthesis, implementation partners and PI; **Estimated Task Hours (PI):** TBD.

Planned Accomplishments:

Feasibility assessment of the reaction vessel's functionality in microgravity.
Execution of nanocrystal growth experiments in the ISS environment.
Data collection to validate the vessel's design and performance under real microgravity conditions.

Part 5: Related R/R&D

Fluid Dynamics in Microgravity: ISS experiments study fluid behavior in microgravity; Capillary flow research focuses on fluid movement in narrow spaces; Microgravity simulators provide data on reduced gravity fluid behavior.

Fluid Control Systems: Development of microgravity fluid control systems; Use of passive mixing and microfluidics for precise control.

Cryogenic Fluid Management: Research in managing cryogenic fluids in space; Applicable principles to fluid control in nanocrystal growth.

Computational Fluid Dynamics (CFD): CFD simulations model fluid behavior in microgravity; Virtual testing for optimizing nanocrystal growth conditions.

Spintronics and Quantum Sensors: Spintronics for fluid dynamics control and monitoring; Quantum sensors enhance precision in fluid properties monitoring.

Space Applications of Spintronics and Quantum Sensors: Adaptation of space-tested Spintronics and sensors for nanocrystal growth.

Nanocrystal Growth Research: ISS experiments on nanocrystal growth in microgravity; Improved nanocrystal properties in microgravity.

Biological and Material Science Research: Insights from ISS experiments applicable to nanomaterial behavior.

Crystal Growth in Simulated Microgravity: Studies on fluid dynamics and crystal growth in simulated microgravity.

Materials Science Advances in Space: Enhanced material properties in microgravity; Direct relevance to optimizing nanocrystal growth in space.

Part 6: Subcontractors/Consultants

There are no Subcontractors/Consultants who will be working on this project. Not applicable.

Part 7: Related, Essentially Equivalent, and Duplicate Proposals and Awards

1. **Name of Agencies:** ISS National Lab; **Date of Proposal Submission:** April 5, 2023

Title, Number, and Date of Solicitations: NLRA 2023-6: In-space Production Applications: Advanced Materials and Manufacturing, Open period: 02/13/2023 – 07/20/2023; **Specific Applicable Research Topics:** In-Space Production Applications: Advanced Materials and Manufacturing; **Titles of Research Projects:** Exploring alternative materials and methods for synthesizing quantum dots that are less toxic and more sustainable.

Name and Title of Principal Investigator or Project Manager: Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.

2. **Name of Agencies:** ISS National Lab; **Date of Proposal Submission:** April 5, 2023

Title, Number, and Date of Solicitations: NLRA 2023-6: In-space Production Applications: Advanced Materials and Manufacturing, Open period: 02/13/2023 – 07/20/2023; **Specific Applicable Research Topics:** In-Space Production Applications: Advanced Materials and Manufacturing; **Titles of Research Projects:** Studying the fundamental physics of optical phenomena in microgravity environments, such as Bose-Einstein condensates, to better understand the behavior of matter and light in space; **Name and Title of Principal Investigator or Project Manager:** Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.

3. **Name of Agencies:** ISS National Lab; **Date of Proposal Submission:** Aug 9, 2023

Title, Number, and Date of Solicitations: NLRA 2023-8: TECHNOLOGY ADVANCEMENT AND APPLIED RESEARCH LEVERAGING THE ISS NATIONAL LAB, Open period: 5/15/2023 – 10/9/2023; **Specific Applicable Research Topics:** TECHNOLOGY ADVANCEMENT AND APPLIED RESEARCH LEVERAGING THE ISS NATIONAL LAB; **Titles of Research Projects:** Experiments with Silicon Quantum Dots and Silicon Quantum Dots Spin Qubits in the Microgravity Environment; **Name and Title of Principal Investigator or Project Manager:** Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.

4. **Name of Agencies:** ISS National Lab; **Date of Proposal Submission:** Aug 9, 2023;

Title, Number, and Date of Solicitations: NLRA 2023-8: TECHNOLOGY ADVANCEMENT AND APPLIED RESEARCH LEVERAGING THE ISS NATIONAL LAB, Open period: 5/15/2023 – 10/9/2023; **Specific Applicable Research Topics:** TECHNOLOGY ADVANCEMENT AND APPLIED RESEARCH LEVERAGING THE ISS NATIONAL LAB; **Titles of Research**

Firm name: Bubbles & Café Inc.

Project title: Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Growth in Microgravity.

Projects: Assessing QD-Cell interactions for safer biomedical use in the microgravity environment; **Name and Title of Principal Investigator or Project Manager:** Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.

5. **Name of Agencies:** ISS National Lab; **Date of Proposal Submission:** Aug 9, 2023;

Title, Number, and Date of Solicitations: NLRA 2023-8: TECHNOLOGY ADVANCEMENT AND APPLIED RESEARCH LEVERAGING THE ISS NATIONAL LAB, Open period: 5/15/2023 – 10/9/2023; **Specific Applicable Research Topics:** TECHNOLOGY ADVANCEMENT AND APPLIED RESEARCH LEVERAGING THE ISS NATIONAL LAB; **Titles of Research Projects:** Zero-G Lithium: Microgravity Magnesiothermic Reduction for Sustainable Manufacturing; **Name and Title of Principal Investigator or Project Manager:** Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.

6. **Name of Agencies:** National Science Foundation; **Date of Proposal Submission:** July 8, 2023;

Title, Number, and Date of Solicitations: NSF SBIR/STTR Project Pitch; **Specific Applicable Research Topics:** Advanced Materials (AM); **Titles of Research Projects:** Research and development of novel materials and fabrication methods for spin qubits and quantum dots; **Name and Title of Principal Investigator or Project Manager:** Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.

7. **Name of Agencies:** National Science Foundation; **Date of Proposal Submission:** June 6, 2023;

Title, Number, and Date of Solicitations: NSF SBIR/STTR Project Pitch; **Specific Applicable Research Topics:** Nanotechnology (N); **Titles of Research Projects:** Develop quantum dots that are less toxic and more sustainable, and to explore their applications in quantum computing, sensing and detection, as well as laser technology. **Name and Title of Principal Investigator or Project Manager:** Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.

8. **Name of Agencies:** National Science Foundation; **Date of Proposal Submission:** May 29, 2023;

Title, Number, and Date of Solicitations: NSF SBIR/STTR Project Pitch; **Specific Applicable Research Topics:** Internet of Things (I); **Titles of Research Projects:** Cloud Native AIOS IoT Smart Restaurant with Smart Kitchen for Contactless Food Preparation, Ordering & Vending; **Name and Title of Principal Investigator or Project Manager:** Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.

Proposals planned for submission:

9. **Name of Agencies:** National Science Foundation, **Date of Proposal Submission:** To be submitted;

Title, Number, and Date of Solicitations: NSF SBIR/STTR Project Pitch; **Specific Applicable Research Topics:** Nanotechnology (N), Advanced Materials (AM); **Titles of Research Projects:** Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Growth in Microgravity **Name and Title of Principal Investigator or Project Manager:** Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.

10. **Name of Agencies:** ISS National Lab; **Date of Proposal Submission:** To be submitted;

Title, Number, and Date of Solicitations: NLRA 2023-10 IGNITING INNOVATION: SCIENCE IN SPACE TO CURE DISEASE ON EARTH; **Specific Applicable Research Topics:** Advanced technologies for biomanufacturing **Titles of Research Projects:** Leveraging Spintronics, Spin-Based Quantum Sensors, and Optimization of Fluid Dynamics for Enhanced Nanocrystal Growth in Microgravity; **Name and Title of Principal Investigator or Project Manager:** Ilakkuvaselvi Manoharan, CEO, Bubbles & Café Inc.