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Acoustic Levitation Assisted Contactless Multimaterial Printing

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Background

In the ever-evolving landscape of biotechnology, the quest to understand and replicate cell structures has led to a surge in the study of artificial cells. Mimicking the complexities of natural cells, particularly their intracellular compartments, is vital for unlocking various applications, such as addressing challenges in liver disease treatment. In order to effectively fabricate these artificial cells, it is essential to study and develop similar compartmentalized structures, as they are the basis of cell functionality. However, current methods of fabrication, such as top-down and bottom-up approaches, fail to investigate these methods due to current difficulties in creating controllable multicompartmental structures.

Acoustic levitation by ultrasonic arrays presents a promising, low-cost alternative for printing soft materials, though this method has yet to be properly explored. This technology holds untapped potential for creating spherical artificial cells, which would foster a deeper understanding of cell structure and operation, thus opening doors for breakthroughs in drug delivery and high-quality artificial cell generation.

Invention Description

Researchers at Arizona State University have developed a novel approach for the fabrication of artificial cells referred to as Acoustic Levitation-Assisted Contactless Droplet Printing (ALCDP). This invention introduces a contactless droplet suspension system, leveraging acoustic levitation to fabricate mononuclear or multinucleated artificial cellular structures. The research team developed illumination strategies tailored to the light sensitivity of materials, enabling the fabrication of resilient shell structures as thin as tens of microns that are capable of returning to their original shape after large ratios of deformation. This process, paired with a novel oil trapping-based manufacturing process, provided an effective platform for the fabrication of single-core and multi-core cell structures at least 3 times smaller than those produced by conventional methods. This method presents a new approach to processes such as separation, mixing, and evaporation that occur in the generation of new smart materials and structures. By combining droplet microfluidics with the contactless and non-invasive method of acoustic manipulation, this method can combat the challenge of high-order emulsification during the fabrication of artificial cells.

Potential Applications

- Artificial cell generation
- Drug delivery systems
- Disease treatment

Benefits and Advantages

- Contactless and non-invasive artificial cell manufacturing
- Low-cost alternative for soft material printing
- Small spherical cell-structure (as small as 300-800 μm)
- Thin membrane (as small as tens of microns)