

# Microfluidic Droplet for Drug Delivery and Therapeutic Applications

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## **A hydrogel microspheres using biocompatible synthetic material that can encapsulate viable cells and bioactive molecules using a novel microfluidic droplet system**

Inventors at Georgia Tech have demonstrated that hydrogel microspheres using biocompatible synthetic material can encapsulate viable cells and bioactive molecules using a novel microfluidic droplet system. Cells, biomolecules, and drugs are suspended in liquid polymer solution and then extruded in droplet-form via microfluidics into a continuous phase solution containing an oil-crosslinker mixture. This unique method creates well-defined structures that allow for quick reactions and in situ delivery to the patient. The microspheres are comprised of biocompatible polyethylene glycol-based (PEG) polymer, and the diameter size of the beads (ranging from 10-1000 micrometers) can be fine-tuned by adjusting the nozzle dimensions and flow rates of the microfluidic droplet system. The hydrogel microspheres and their degradation by-products are non-toxic and do not elicit an inflammatory response.

### **Summary Bullets**

- Viable, cellular micro-environments requiring precise control are achieved using hydrogel microspheres with diameter sizes ranging from 10-1000 micrometers
- A protective, semi-permeable capsule encases the cells and biomolecules
- Release rates of encapsulated biomolecules or drugs are controlled by adjusting the polymer parameters used to fabricate hydrogel microspheres

### **Solution Advantages**

- Viable, cellular micro-environments requiring precise control are achieved using hydrogel microspheres with diameter sizes ranging from 10-1000 micrometers
- A protective, semi-permeable capsule encases the cells and biomolecules
- Release rates of encapsulated biomolecules or drugs are controlled by adjusting the polymer parameters used to fabricate hydrogel microspheres

### **Potential Commercial Applications**

- Injectable hydrogels integrating pancreatic islets and VEGF for islet vascularization
- Micro-coatings for immuno-isolation

- Cell-based drug delivery systems for treatment

## Background and More Information

Micro-encapsulation of cells in semi-permeable polymer networks is a promising approach for avoiding immunosuppressive therapy in allogeneic, xenogeneic and genetically modified cell transplantation. Current technology uses an electrostatic droplet generator and alginate-based polymers. Major drawbacks to this system are that cellular micro-spheres are limited to larger diameter sizes (>200 micrometers) and alginate-based polymers provide minimal control over the cellular micro-environment. By utilizing advanced synthetic polymers, bioactive molecules can be chemically conjugated, and the cellular micro-environment can be fine-tuned based on therapeutic application.

## Inventors

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## IP Status

<p>Patent has issued</p>: US9381217B2

## Publications

[Protease-degradable microgels for protein delivery for vascularization](#), Biomaterials - January 2017

## Images

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