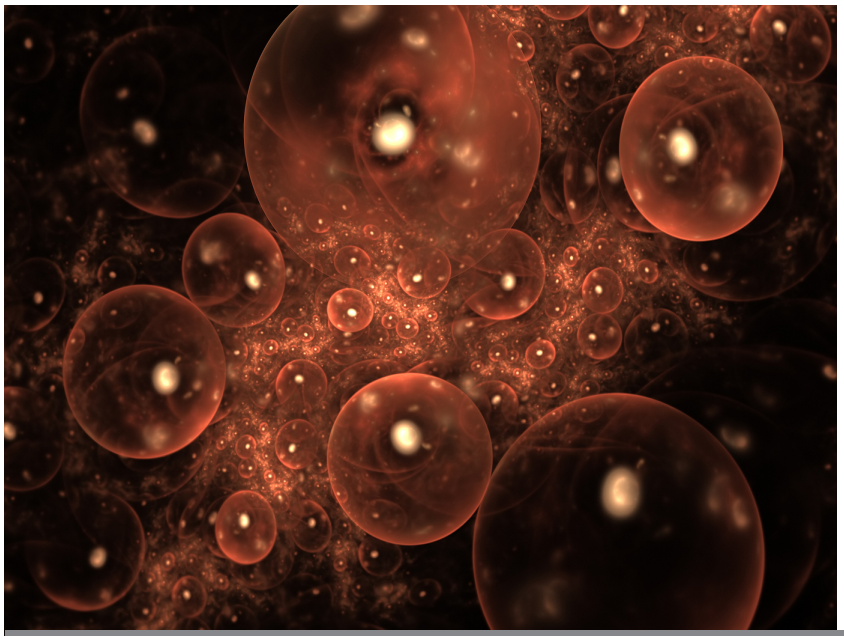


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Health, Medicine and Biotechnology

3D Construction of Biologically Derived Materials

System for the 3D Construction of Biologically Derived Materials, Structures, and Parts

NASA has developed a novel approach for macroscale biomaterial production by combining synthetic biology with 3D printing. Cells are biologically engineered to deposit desired materials, such as proteins or metals, derived from locally available resources.

The bioengineered cells build different materials in a specified 3D pattern to produce novel microstructures with precise molecular composition, thickness, print pattern, and shape. Scaffolds and reagents can be used for further control over material product. This innovation provides modern design and fabrication techniques for custom-designed organic or organic-inorganic composite biomaterials produced from limited resources.

BENEFITS

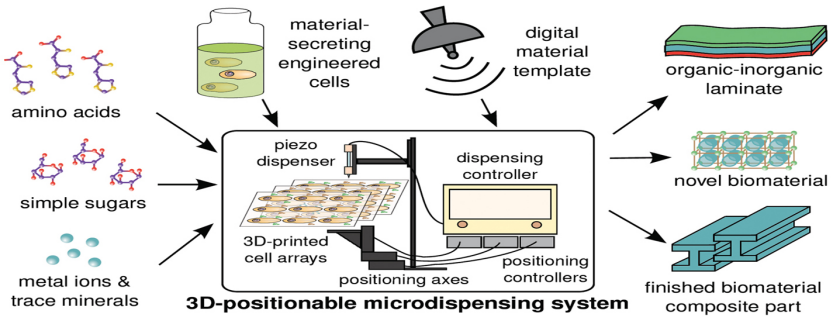
- Conserves resources. Few raw or bulk starting materials needed
- Enables custom design of diverse materials
- Fast, portable, macroscale, on-demand manufacturing
- High-fidelity microstructures
- Uses commercially available parts

THE TECHNOLOGY

Once genes for a desired material type, delivery mode, control method and affinity have been chosen, assembling the genetic components and creating the cell lines can be done with well-established synthetic biology techniques. A 3D microdeposition system is used to make a 3D array of these cells in a precise, microstructure pattern and shape.

The engineered cells are suspended in a printable 'ink'. The 3D microdeposition system deposits minute droplets of the cells onto a substrates surface in a designed print pattern. Additional printer passes thicken the material. The cell array is fed nutrients and reagents to activate the engineered genes within the cells to create and deposit the desired molecules. These molecules form the designed new material. If desired, the cells may be removed by flushing. The end product is thus a 3D composite microstructure comprising the novel material.

This innovation provides a fast, controlled production of natural, synthetic, and novel biomaterials with minimum resource overhead and reduced pre- and post-processing requirements.



Process inputs and outputs

APPLICATIONS

The technology has several potential applications:

- Biomaterials, biotechnology
- Organic-inorganic composite materials
- On-demand manufacturing
- In situ resource utilization
- Space stations
- Military
- Infrastructure materials

PUBLICATIONS

Patent No: 10,815,474

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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