Investigation seeks to create self-assembling materials

May 16 2018, by Jenny Howard

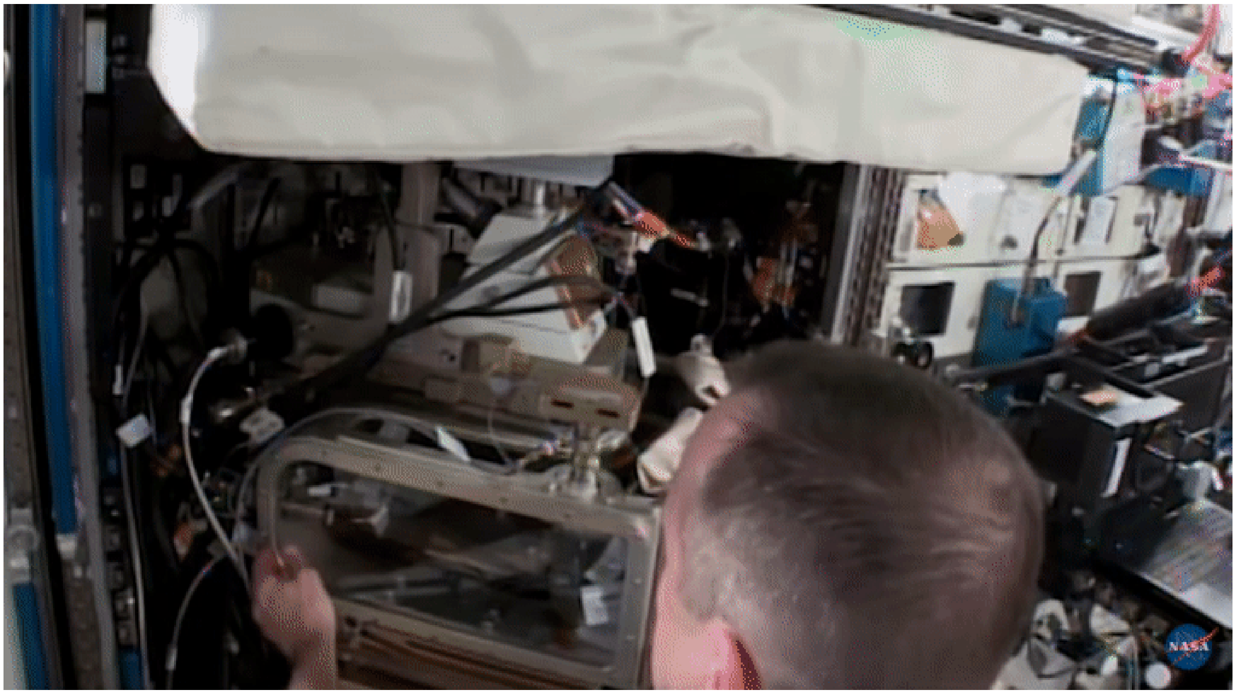
NASA astronaut Scott Tingle works within the Light Microscopy Module (LMM), the facility in which ACE-T-7 will take place. Credit: NASA

As we travel farther into space, clever solutions to problems like engine part malfunctions and other possible mishaps will be a vital part of the planning process. 3-D printing, or additive manufacturing, is an emerging technology that may be used to custom-create mission-critical parts. An integral piece of this process is understanding how particle shape, size distribution and packing behavior affect the manufacturing process.

The Advanced Colloids Experiment-Temperature-7 investigation (ACE-T-7) aboard the International Space Station explores the feasibility of creating self-assembling microscopic particles for use in the manufacturing of materials during spaceflight. These microscopic particles come together like building blocks to create materials with tailored nanostructures, giving scientists the ability to change the behavioral properties of a material according to a set of instructions embedded within the particle.

The ability for materials to self-assemble, and potentially self-repair following a breakdown, will be a key element as we head to deep space destinations, where bringing along extra engine parts and other necessary items may not be an option because of storage limitations aboard the spacecraft.

"You're going to have to take along powders and colloids comprised of shape- and size-specific microscopic particles that fit together different ways; then a machine can use these novel materials to make replacement parts so people can survive and fix things," said Paul Chaikin, the investigation's primary investigator and a professor of physics at New York University.

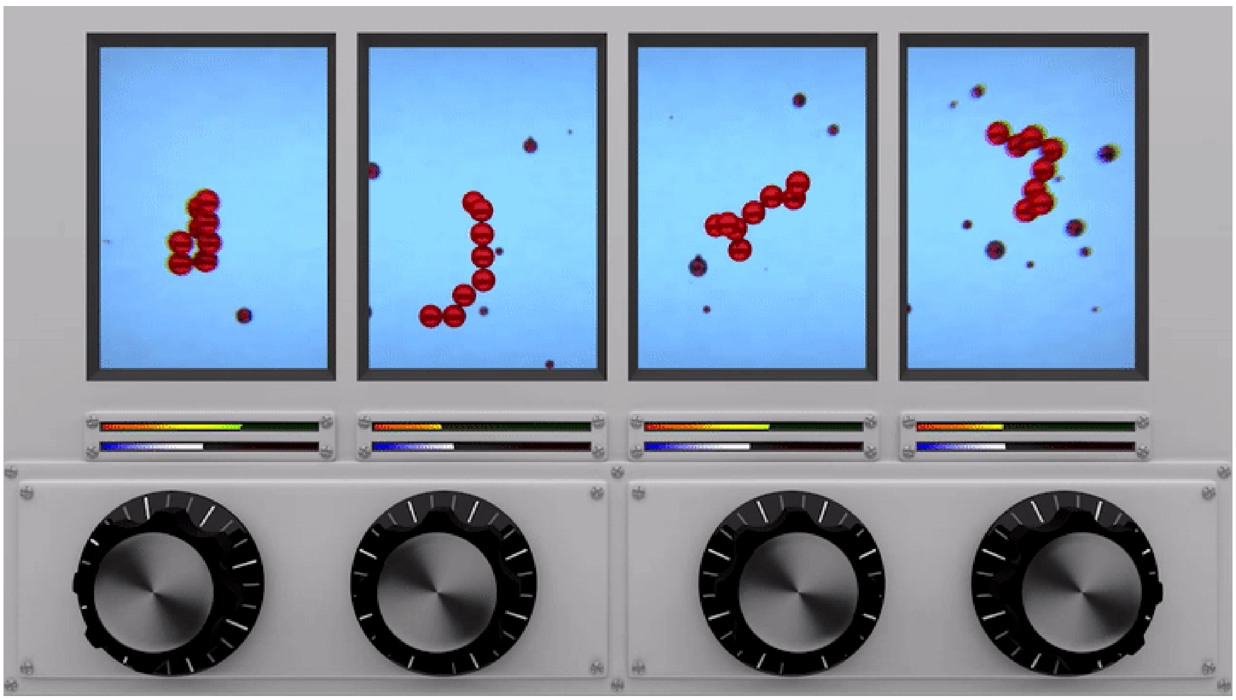


NASA astronaut Ricky Arnold works within the Light Microscopy Module (LMM). Credit: NASA

Using different forms of energy as "control knobs," scientists could embed a code at the nano-level of a material, giving it different instructions for various conditions. In the case of ACE-T-7, researchers are manipulating temperature to control the assembly and interactions of the particles. Suspended in a fluid medium, these particles are designed to bind to one another in specific ways to form 3-D crystals when exposed to high or low temperatures.

"At one temperature, one crystallization phase is favored and at another, another crystallization phase is favored," said New York University's Stefano Sacanna, one of the project's co-investigators. "Essentially temperature is an external stimuli to guide and help the particles bind in the right fashion. It is one way for us to guide them or control their assembly."

This process is not much different from how living things are made in nature—building blocks that are strung together, behaving according to their genetic code.



Researchers are manipulating temperature to control the assembly and interactions of the particles. Suspended in a fluid medium, these particles are designed to bind to one another in specific ways to form 3-D crystals when exposed to high or low temperatures. Credit: NASA/iGoal Animation

"We try to understand the self-assembly of matter and potentially use this as a way to manufacture new materials," said Sacanna.

On Earth, the force of gravity pulls all of the crystals to the bottom of the container, not allowing for observation. The microgravity environment of the space station allows researchers to observe how the crystals are growing, as well as separate the effects of gravity on the investigation.

"In the microgravity environment, the force on the particles is almost a million times smaller, so they will remain suspended in the fluid medium, and 3-D crystals can be grown and observed without the damaging effects of sedimentation," said New York University's Andrew Hollingsworth, the one of the project's co-investigators.

An increased understanding of how all of these particles interact together will help researchers bring this science to Earth in the form of additive manufacturing, in an effort to create evolvable materials with optimal properties.

Provided by NASA

Citation: Investigation seeks to create self-assembling materials (2018, May 16) retrieved 9 April 2024 from https://phys.org/news/2018-05-self-assembling-materials.html