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Imagine landing on the moon or Mars, putting rocks through a 3D printer, and making something useful—like a needed wrench or replacement part.

"It sounds like science fiction, but now it's really possible," says Amit Bandyopadhyay, professor in the School of Mechanical and Materials Engineering at Washington State University.

Bandyopadhyay and a group of colleagues published a paper in *Rapid Prototyping Journal* demonstrating how to print parts using materials from the moon.

Approached by NASA

Bandyopadhyay and Susmita Bose, professor in the School of Mechanical and Materials Engineering, are well-known researchers in the area of 3D printing for creation of bone-like materials for orthopedic implants.

In 2010, researchers from NASA initiated discussion with Bandyopadhyay, asking if the research team might be able to print 3D objects from moon rock.

Because of the tremendous expense of space travel, researchers strive to limit what space ships have to carry. Establishment of a lunar or Martian outpost would require using the materials that are on hand for construction or repairs. That's where the 3D fabrication technology might come in.

3D fabrication technology, also known as additive manufacturing, allows researchers to produce complex 3D objects directly from computer-aided design (CAD) models, printing the material layer by layer. In this case, the material is heated using a laser to high temperatures and prints out like melting candle wax to a desired shape.

Simple shapes built

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To test the idea, NASA researchers provided Bandyopadhyay and Bose with 10 pounds of raw lunar regolith simulant, an imitation moon rock that is used for research purposes.

The WSU researchers were concerned about how the moon rock material—which is made of silicon, aluminum, calcium, iron, and magnesium oxides—would melt. But they found it behaved similarly to silica, and they built a few simple shapes.

The researchers are the first to demonstrate the ability to fabricate parts using the moon-like material. They sent their pieces to NASA.

"It doesn't look fantastic, but you can make something out of it," says Bandyopadhyay.

Tailoring composition, geometry

Using additive manufacturing, the material could also be tailored, the researchers say. If you want a stronger building material, for instance, you could perhaps use some moon rock with earth-based additives.

"The advantage of additive manufacturing is that you can control the composition as well as the geometry," says Bose.

In the future, the researchers hope to show that the lunar material could be used to do remote repairs.

"It is an exciting science fiction story, but maybe we'll hear about it in the next few years," says Bandyopadhyay. "As long as you can have additive manufacturing set up, you may be able to scoop up and print whatever you want. It's not that far-fetched."

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