

NATURAL FEED-STOCKS FOR FABRICATION OF SPARE PARTS = SUSTAINABILITY FOR PLANETARY MISSIONS


Bonnie Cooper

David McKay

Presented by Dr. Tai Sik Lee

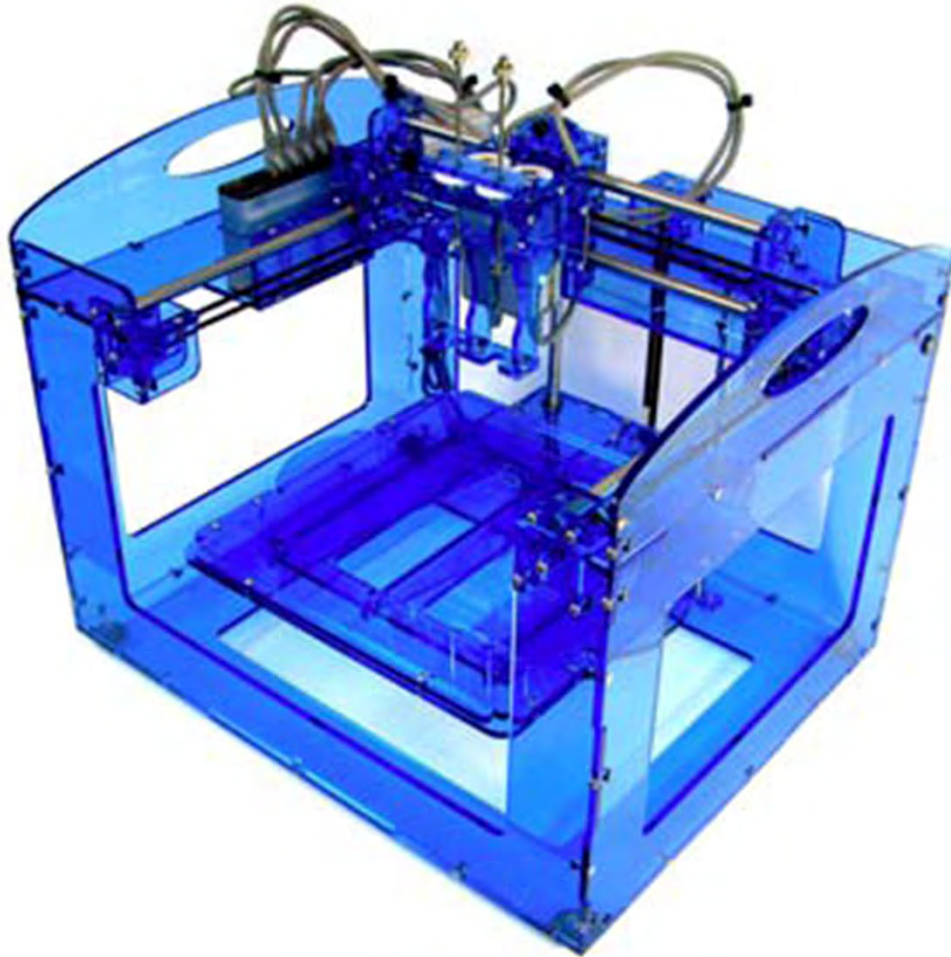
Greetings from Korea!

A breakfast fruit.
You must peel it before you can
eat it.

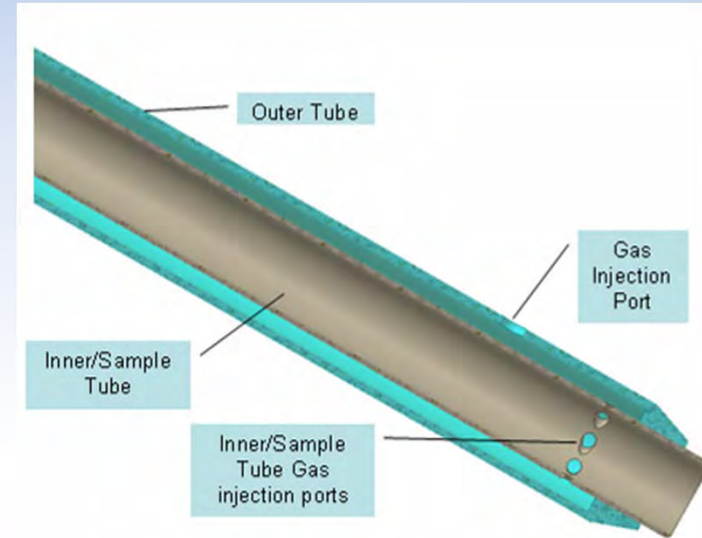
A photograph of a white ceramic plate set on a textured, light-brown placemat. On the plate, there is a round, spiky red fruit, likely a Korean chestnut (dangmyeong), which is covered in long, thin, reddish-brown spines. Next to it is a whole, bright orange. A silver knife is visible on the right side of the plate, and a portion of a silver spoon is on the far right. The background is a solid light blue.

Thanks to Dr. Tai Sik Lee for inviting me to Korea,
And for giving this talk.

Additive Manufacturing



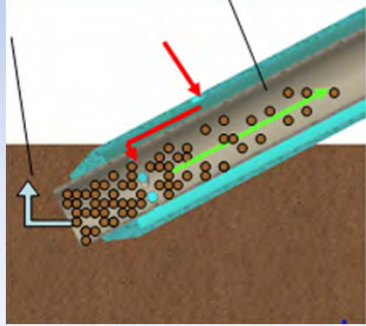
Feedstock Preparation



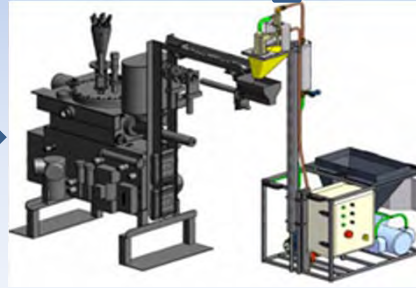
Zacny et al., 2008



Cooper et al., 2010



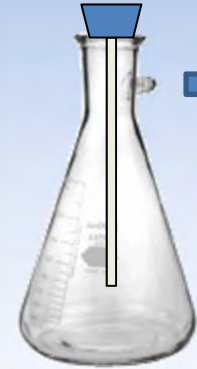
Pneumatic Transport



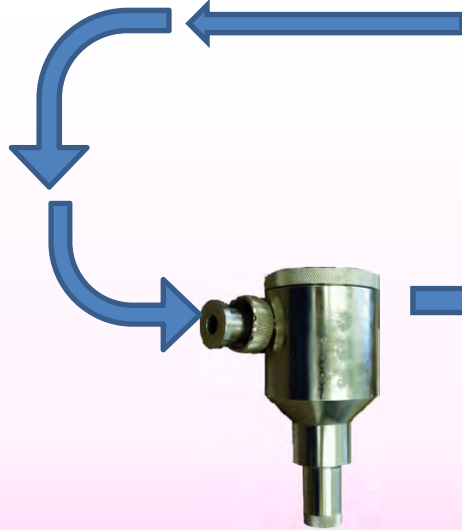
Oxygen Plant



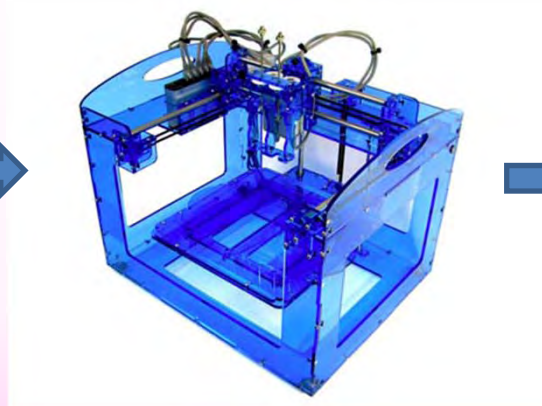
Fluidized Bed



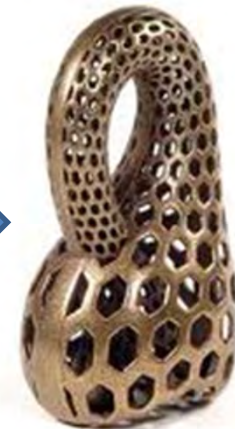
Impactor/
Settling Flask



Cyclone

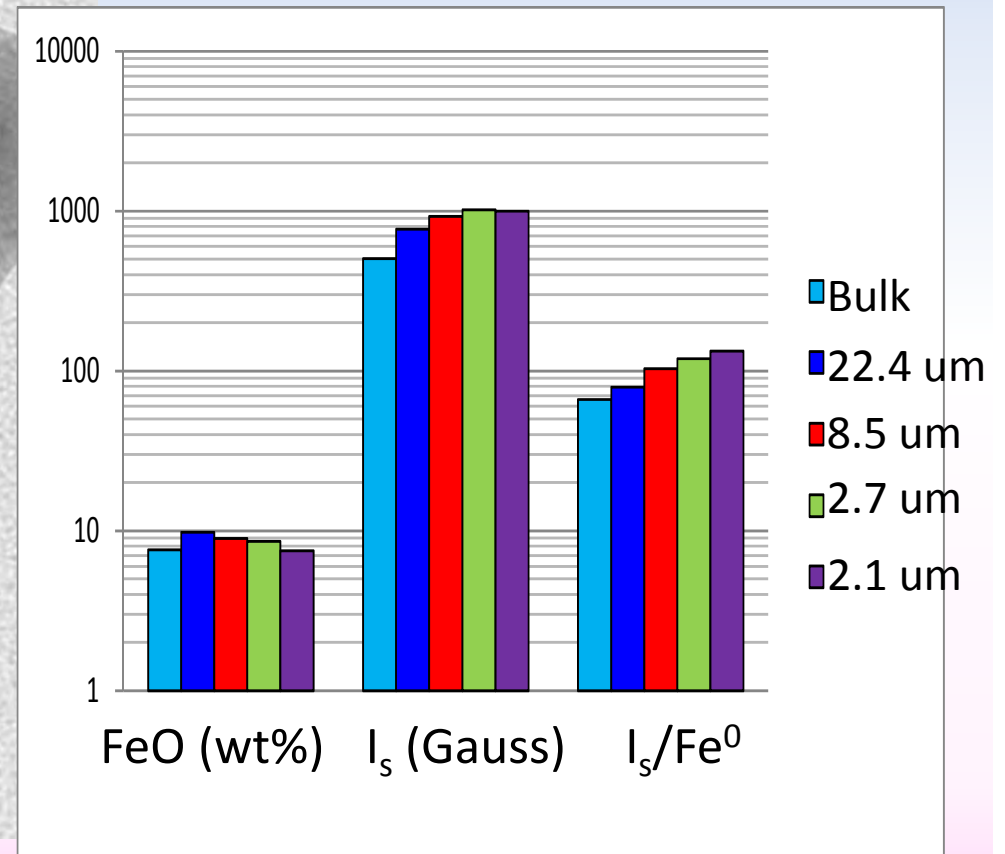
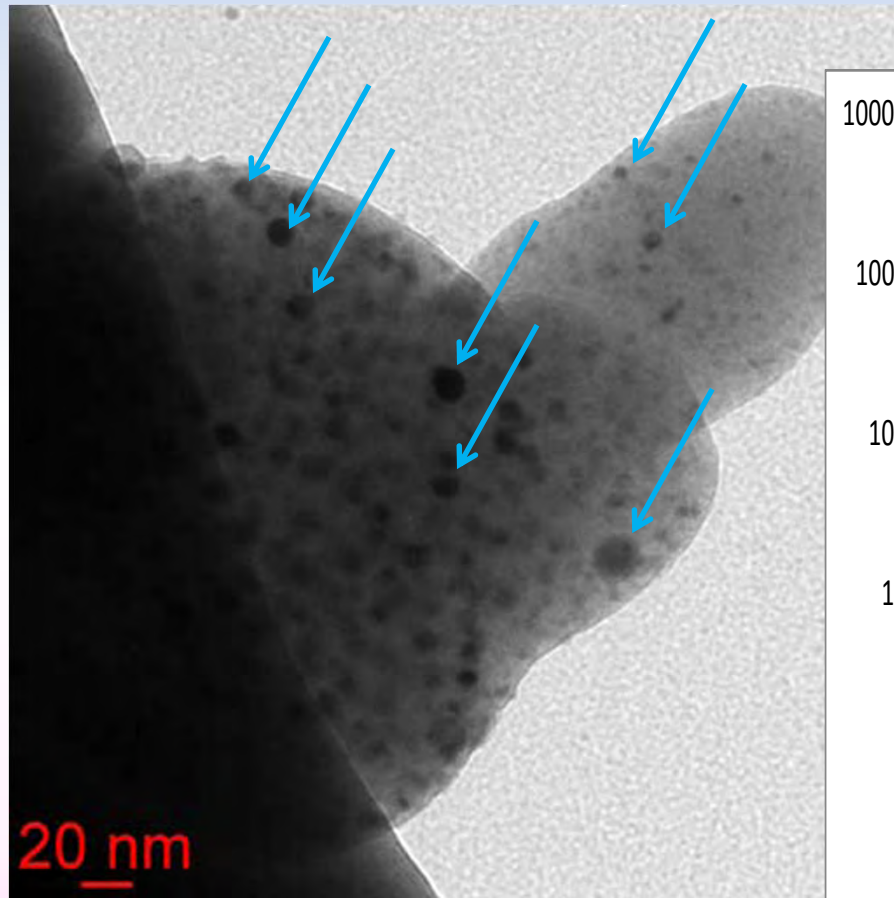


3D Printer



Useful Part

Native Iron Content of Lunar Soil

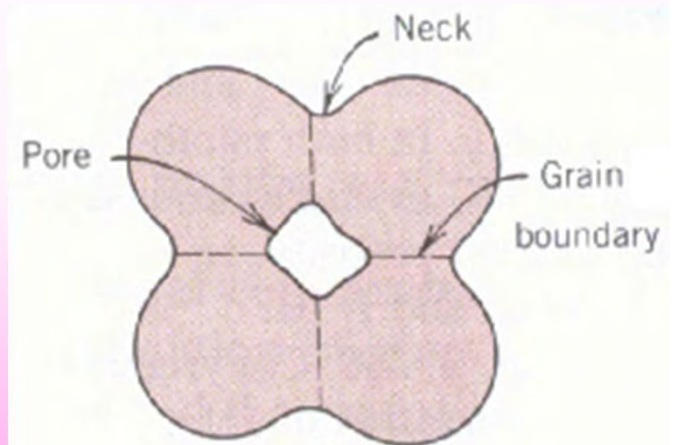


$FeO \neq Fe^0$!!!!!

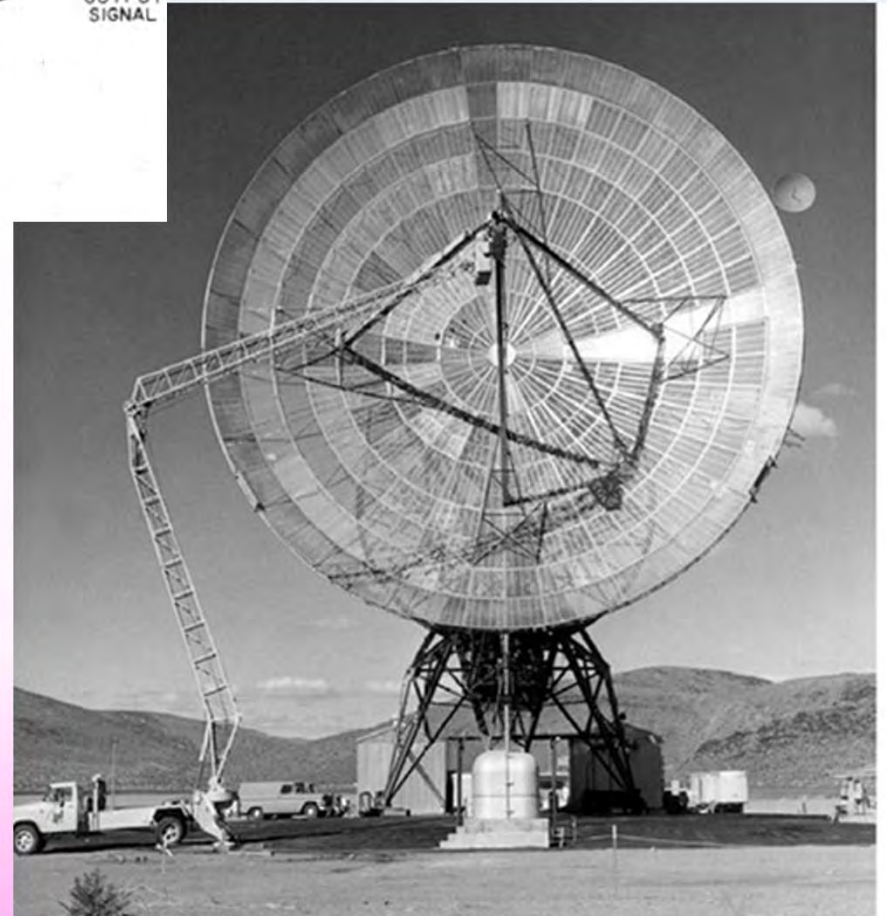
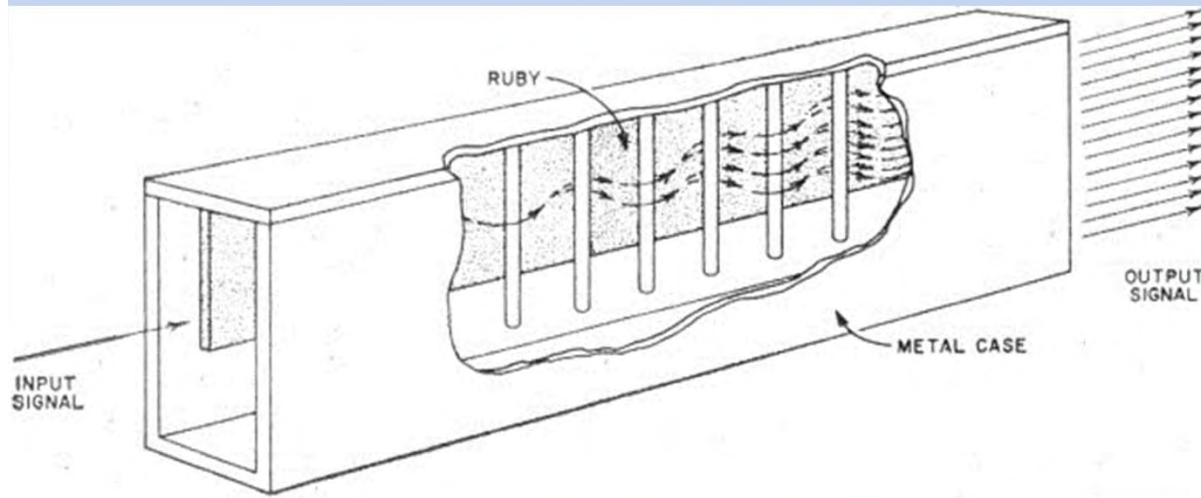
Submitted for publication, May 2013,
McKay, Taylor, Cooper and 6 others.

Native Iron Content of Lunar Soil

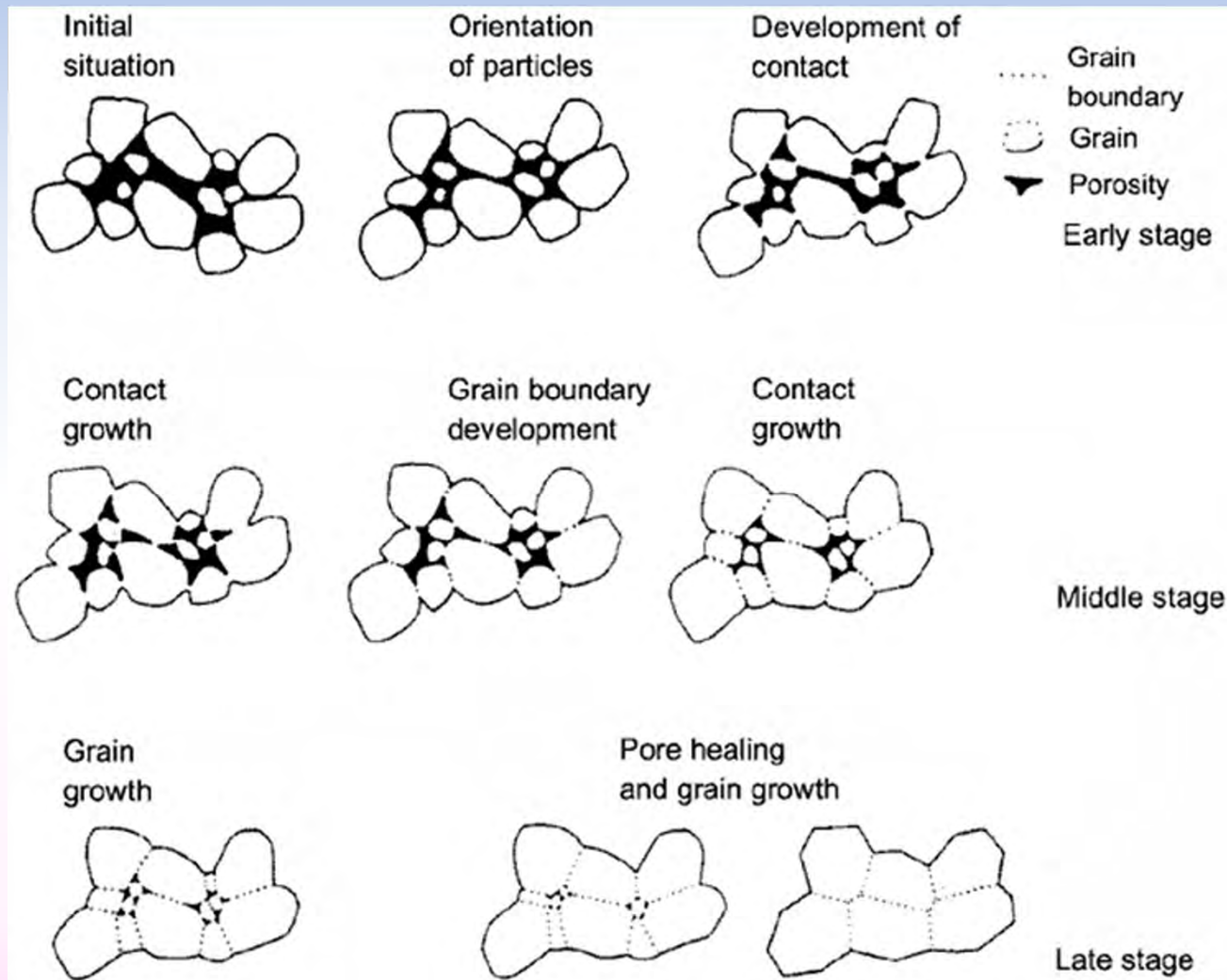
Material	Melting Point
Iron (Fe^0)	1127 - 1149 °C
FeO	1377 °C
Fe_2O_3	1566 °C
Fe_3O_4	1538 °C



Lasers and Masers



Microwave sintering of lunar soil



Taylor, L.A. and T.T. Meek, *Microwave Sintering of Lunar Soil: Properties, Theory, and Practice*. Journal of Aerospace Engineering, 2005. **18**: p. 188.

Conclusion

- 3D printing by fused deposition can be used on lunar soil.
- The soil can be precisely size-separated to make the 3D printing process work efficiently.
- Using a MASER instead of a LASER would allow us to use the finest fraction of lunar soil, AS-IS, to manufacture things on the Moon.