

March 16th, 2020  
Graduate School of Agricultural and Life Sciences, The University of Tokyo  
Japan Manned Space Systems Corporation

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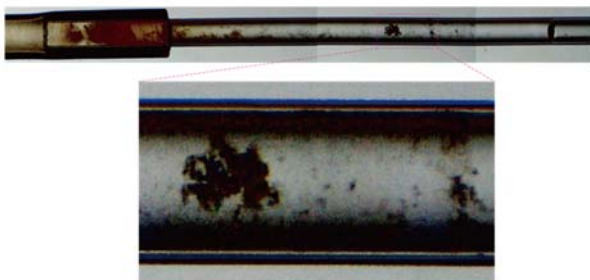
## First cellulose synthesis by enzyme in space

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The research team lead by Dr. Naoki Sunagawa and Associate Professor Kiyohiko Igarashi from the Graduate School of Agricultural and Life Sciences, the University of Tokyo, synthesized cellulose enzymatically under the microgravity environment of space for the first time in the world, using the high quality protein crystal growth service "Kirara" provided by Japan Manned Space Systems Corporation (JAMSS).

The cellulose was synthesized in a small incubator developed by JAMSS on the International Space Station (ISS), using an enzyme sample prepared by Associate Professor Igarashi and coworkers (reference). The incubator was launched to the ISS by Space X CRS-19 on December 6, 2019 and the cellulose molecular grown over a period of approximately one month, after which the incubator returned to Earth on January 8, 2020.

Cellulose is the most abundant and renewable biological resource (biomass) on Earth. At a ground condition, the cellulose synthesized by enzyme is precipitated by gravity in vitro. It is generally known that substances are uniformly mixed without sedimentation under the microgravity environment in space, and crystals grow without being affected by natural convections. For the first time in the world, the attempt was made to synthesize cellulose enzymatically in space and the resulting uniform cellulose has been found to be different from cellulose precipitated on the ground. Further analysis of the structure of cellulose obtained in the space environment and investigation of its properties will be undertaken. By obtaining cellulose with a structure and properties different from those on the ground, it is expected to open new material research possibilities.



Cellulose enzymatically synthesized on the ground  
is heterogeneously synthesized



Cellulose enzymatically synthesized in microgravity  
is uniformly synthesized

### Reference

Hiraishi, M., Igarashi, K., Kimura, S., Wada, M., Kitaoka, M., and Samejima, M., Synthesis of highly ordered cellulose II in vitro using cellodextrin phosphorylase, Carbohydr. Res. 344:2468-2473 (2009)

■ About Kirara

Kirara is a high quality protein crystal growth service provided by JAMSS for drug discovery support. This technology was realized through a technical tie-up with Confocal Science, which has been supporting protein crystal generation on ground and in space since its foundation in 1994. The small incubator, which JAMSS developed and in which crystals are grown, is launched through the ICE Cubes Service and accommodated in the ICE Cubes Facility (ICF) owned by Space Applications Services who has a commercial partnership with the European Space Agency (ESA). Kirara is a commercial service partnership between Japanese and European companies. This achievement has expanded the possibilities which Kirara's services can provide not only to drug discovery support but also to the field of materials.

News release about Kirara mission:

<https://www.jamss.co.jp/en/news/index.html?idx=T1575583339>

<https://www.jamss.co.jp/en/news/index.html?idx=T1579695670>



1U (10cm cubic) size incubator

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