Thermal diffusivity measurement on a particle from the asteroid Ryugu using a non-contact measurement technique

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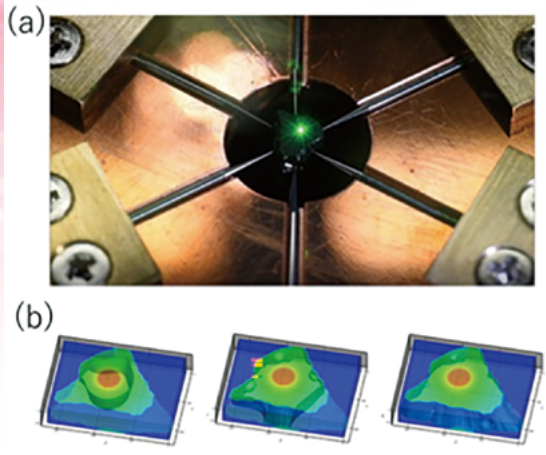
The asteroid explorer Hayabusa2 has brought a total of approximately 5.4 g of particles from the asteroid Ryugu to Earth. The thermophysical properties of the asteroid are valuable information that can reveal the details of chemical reactions and material formations inside an early parent asteroid. The particle tested was a few millimeters square in area, and additional processing and installation of sensors were not allowed to avoid contamination. Therefore, we adopted a non-contact thermal diffusivity measurement technique known as laser spot periodic heating radiation thermometry.



(a) photograph of the measured Ryugu particle set in the chamber and (b) typical simulation results to derive thermal diffusivity.

The sample was held by six needles in a high-vacuum chamber and the surface was periodically heated with a laser spot. The temperature change at the rear surface was detected by infrared radiation measurement using a high-spatial-resolution Ge lens and a liquid nitrogen-cooled InSb infrared sensor. Furthermore, we conducted temperature simulations of the particle using a computer cluster to determine the thermal diffusivity. The obtained thermal diffusivity is $(3.2 \pm 0.3) \times 10^{-7}$ m^2 s^{-1}, indicating that the thermophysical properties of the particle are similar to those of resin.

The obtained thermophysical property has been used in various numerical simulations to explore the early formation and thermal evolution of Ryugu, contributing to research on the formation of the solar system.