Thermal infrared measurement of impact in laboratory experiment

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Ground based observations of Lunar impact flash with visible wavelength contributes progress of the impact physics. Meanwhile, the visible observations are restricted to the direct flash at the night side. When the thermal infrared emission from an impact is observed, coverage can be expanded not only to the nightside but also to the dayside. The thermal infrared observation also would detect residual hot spot after the impact event. When the temperature variation is derived from the continuous observation of the residual hot spot, thermal inertia, from which an energy budget correlated with size of the crater, would be obtained. Epoch of the impact and the temperature at that time may be estimated from the thermal relaxation profile even if the impact could not be directly detected. As a first step, we have measured artificial impact flashes using a thermal infrared camera in a laboratory experiment.

The impact experiment with 15 shots has been carried out in a vacuum chamber. SiO_2 sand with ~345 μm diameter was set inside, and an uncooled microbolometer array (UMBA) camera detecting the thermal infrared wavelengths at 10 μm (8 -14 μm) was configured outside of the chamber. Thermal infrared images were continuously obtained with 10 Hz via a thermal transmission window. When a polycarbonate impactor with a size of 2 mm struck the sand with a speed of 6.6 km/s, the temperature distribution and profile of the crater created on the sand surface was obtained from brightness temperature distribution in the UMBA images.
The temperature profile of the sand surface after the impact has been estimated in each pixel using images continuously obtained. The maximum temperatures were estimated to 1700-2600 K at the time of impacts. Notably, the result showed unexpected horizontal temperature distributions; the temperature of the crater limb was higher than that of the crater center at the time of impact. However, the limb temperature drastically decreased less than 1000 K, and the limb temperature became lower than center temperature after 0.5 seconds.

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