MID-INFRARED OBSERVATION OF THE COLLISION BETWEEN DEEP IMPACT PROJECTILE AND COMET 9P/TEMPEL 1 WITH SUBARU/COMICS. T. Ootsubo¹, S. Sugita², T. Kadono³, M. Honda⁴, T. Miyata⁵, S. Sako⁶, I. Sakon⁶, H. Fujiwara⁷, T. Fujiyoshi⁸, T. Yamashita⁹, N. Takato¹⁰, T. Fuse¹¹, and Subaru/COMICS Deep Impact team, ¹Division of Particle and Astrophysical Sciences, Nagoya University, Nagoya 464-8602, Japan (ootsubo@u.phys.nagoya-u.ac.jp), ²Department of Complexity Science and Engineering, University of Tokyo, ³JAMSTEC/IFREE, ⁴JAXA/ISAS, ⁵Institute of Astronomy, University of Tokyo, ⁶Department of Astronomy, University of Tokyo, ⁷NAOJ/Subaru

Introduction: NASA’s Deep Impact (DI) mission generated a hypervelocity collision between its 370kg cooper-based projectile and Comet 9P/Tempel 1 on July 4, 2005 (UT). This collision is expected to excavate fresh cometary material underneath a presumable refractory crust on the surface. Observation of such fresh material rich in pristine volatiles is highly valuable for studying comets and the origin of the Solar System. In order for this study, the information on both cratering process and chemical composition of excavated material is essential. Thus ejecta observation is expected to be extremely important. However, the spectral coverage of the spectrometer on the DI spacecraft is limited to the range between 1.05 and 4.8 µm. Since equilibrium thermal radiation from the comet has its peak around 10 µm, continuous observation of mid-IR radiation will be complementary and hence highly valuable. It is also expected that the use of infrared wavelengths is essential because the coma of 9P/Tempel 1 is optically thick at visible wavelength [1].

Observation: This DI event was observed with the Cooled Mid-Infrared Camera and Spectrometer (COMICS), which is mounted on the 8.2 m Subaru Telescope on Mauna Kea [2,3]. Imaging observations of the pre- and post-impact were done in the 8.8 µm, 10.5 µm, 12.4 µm, 17.7 µm, 18.8 µm, 20.5 µm (and 24.5 µm) bands. N-band low-resolution (R~250) spectroscopic observations were also made from July 3 to 5 (UT). The objective of this observation is to measure accurately the time evolution of the mid-infrared luminosity and spectrum of Comet 9P/Tempel 1 induced by collision.

Results: Subaru/COMICS successfully captured rapidly changing phenomenon occurred around the surface of the comet 9P/Tempel 1. The impact ejecta extending to sizes larger than 2 arcseconds to the south-west direction from the nucleus, which seems like fan-shaped, was detected 2 hours after impact (Fig. 1) in addition to the increased brightness (factor of 4-5) from the baseline measurements of the pre-impact. From both the imaging and spectroscopic observations, it can be concluded that most of the ejected grains are small silicates including the crystalline materials. We will report the preliminary results of analysis about the grain size distribution, composition of the dust minerals, and total mass of the impact ejecta. Information on ejecta grain size will help us infer the strength of the cometary surface and possibly the style of cratering [4]. Such information will be very valuable in considering both cometary surface strength and the effective depth of material excavated by the DI impact. The data of 10 µm spectral feature tells us whether the silicate dust is crystalline or amorphous [e.g. 5]. If most of the ejecta came from only near the cometary surface, it is expected that the information on the silicate dust will show the thermal property of the impact event. On the other hand, if the dust has also been released from inside the nucleus, the crystallinity of the silicate dust may also provide further insight into the origin of comets.

Figure 1. The 10.5 µm image of Comet 9P/Tempel 1 observed by COMICS 2 hours after impact.