PHOTOELECTRIC DUST LEVITATION ABOVE THE SURFACE OF ITOKAWA.

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Hayabusa revealed that Itokawa is covered with boulders and cobbles [1,2], and that powdery material is apparently lack on the surface [2,3]. However, dust grains of sizes up to 180 um are found from sample catchers despite the fact that Hayabusa failed to fire projectiles for use in sample collection. The mechanism by which dust grains had come into dust catchers is not clearly identified yet [1,4], but photoelectric dust levitation [5,6] is thought to be one of possible mechanisms [3,4].

A planetary impact breaks up rocks and/or bedrock into small pieces. Although a fraction of the ejecta might get enough kinetic energy to escape from the gravity to make a source of interplanetary dust [7,8], others return back onto the surface. Break-up of rocks and/or bedrock also occurs by bombardment of micrometeoroids. Thus small pieces of rocks or dust grains are formed continuously on the surface of airless asteroid.

Dust grains at the surface of an asteroid easily levitate due to small gravity. If grains gain enough energy to escape the gravity, the asteroid loses its mass. This could explain the shrinkage of asteroid Itokawa [9]. Otherwise, even when the kinetic energy of dust grain is not enough to escape the gravity, the dust could migrate laterally [6]. In this case dust levitation not only changes the landform features but also affect the thermal evolution of the asteroid since thermal conductivity of dust grain layer is much smaller than rocks or bedrock. If dust grains are heterogeneously distributed on the surface of asteroid, the distribution pattern can be observed as the heterogeneity of thermal inertia [10].

Dust motion within the photoelectric sheath above the surface is not so simple because electric charge of the dust grain changes with time due to sticking of photoelectrons. To trace the dust motion, we need to simulate the time evolution of the charge of the dust grain numerically [5,6,11].

In this study, we simulate vertical motion of dust grains launched from an asteroid. Our numerical code is based on a theoretical model, proposed by Colwell et al. [6] for dust motion on Eros and Moon, but we have revised the model to avoid internal contradictions and to refer previous studies properly.

Our numerical results show that a dust grain as large as 6 um escapes from the gravity of Itokawa by support of electric repulsion, which suggest dust grains finer than 6 um are lost into space and that dust grains larger than 15 um follow a ballistic flight. Thus, we conclude that photoelectric dust levitation mechanism alone cannot explain the size distribution of Hayabusa sample.

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