Ejecta mass produced at collisions of monomers against large dust aggregates

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Collisional growth of dust aggregates is one of the essential processes to form planetesimals. High-velocity collisions produce a large number of small aggregates as ejecta fragments. Since ejecta would play an important role in dust growth and the total ejecta mass is a key to determine the mass loss rate through collisional cascades, we need a model of ejecta mass at high-velocity collisions of dust aggregates [1]. In our previous study, we numerically investigated collisions between aggregates with high mass ratio, i.e., collisions of small aggregates (impactor) against large aggregates (target) [2]. As a result, we found a useful and important scaling relation that the ejecta mass produced at collisions of high mass ratios is proportional to not the kinetic energy but the momentum of impactors. This is interpreted as that the impact energy is sufficiently dissipated within aggregates and the ejecta fragments are driven by the momentum of impactors. There remains, however, a question about the application limit of this scaling relation: What is the effective range of mass ratio for the scaling? To investigate this, we test collisions of monomers against large aggregates as an extreme case of the mass ratio using our numerical code. On the contrary to the previous results, we obtained preliminary results showing that the ejecta mass is proportional to the kinetic energy of monomer impactors. This relation would indicate that the kinetic energy of monomers is directly transferred to the ejecta fragments without significant dissipation. This result is inconsistent with other laboratory experiments [3] and numerical simulations [4]. We discuss the reason of the discrepancy and the application limit of the scaling relation giving ejecta mass at dust aggregate collisions.

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