

Sintering of silica-particle aggregates: Increase of the strength due to neck growth

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Planetesimals are believed to be formed by collision and growth of dust aggregates in protoplanetary disk. However, the process has not been fully understood, yet. We focus to study the physical property of dust aggregates. Sintering is a process in which connection between contacted particles grows when heated below the melting point. This is not negligible phenomenon in the study of the physical property of dust aggregate, because sintering proceeds faster for smaller particles. In this study we investigate the change of strength of the aggregate due to neck growth.

The samples we used are silica microparticles ($0.8 \pm 0.3 \mu\text{m}$ in radius) and soda-lime glass beads (2.5mm in radius). Then they are sintered into cylinders of 5mm diameter and 3mm height, and 4cm and 2cm respectively. Both temperature and sintering duration were changed for both materials. Compressive and tensile strength of the sintered materials were measured. We also measured the neck radius to investigate neck growth due to sintering by scanning electric microscope for silica microparticles and by polarization microscope for soda-lime glass beads samples.

It is expected that the tensile strength of the connection increases in proportion to the neck radius with a power of two. However, the result of this study for silica microparticle samples showed the strength is proportional to the power of 0.97 ± 0.08 of neck radius. We will show the result of soda-lime glass beads samples and compare it to the silica samples.