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# Development of hollow type retroreflector for future LLR - thermal tolerance test of the optical contact surface -

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The contribution of Lunar Laser Ranging (LLR) since its installation in 1969 is quite significant, for example, to the construction of lunar ephemeris and celestial reference frame, gravitational physics, Earth-Moon dynamics, and lunar interior structure. However, one order or more accurate ranging data than present level (2cm as normal point) are needed to enhance our understanding on the lunar deep structure. We are developing ”single aperture and hollow” retroreflector (Corner Cube Mirror; CCM) having no optical pass difference for future lunar landing missions. Last year we presented CCM made of mono crystalline silicon shows the best performance through thermal and optical simulations in the lunar thermal environment. As for the fabrication method of CCM, we investigate mainly ”three-plane bonding” with the optical contact technique, by which three plane mirrors are optically contacted on side with each other. It is known the shear strength of optically contacted surface increases as the annealing temperature becomes high. Quantitative data on this hardening effect are crucial for design and fabrication of CCM. We, therefore, have conducted high temperature exposing experiment of the optically contacted test pieces of mono crystalline silicon in the air from 100 ℃ to 1000 ℃ and confirmed that the shear strength along the thermally processed surface at 1000 ℃ becomes 5 or 6 times higher than original strength and the degradation of surface accuracy and roughness can be ignored. The 20cm aperture CCM model is under fabrication now. Results of accurate measurements of the dihedral angles of the CCM model by ZYGO interferometer will be presented to quantify the effect of the thermal annealing.

Keywords: LLR, CCM, hollow, optical contact, thermal, strength