THERMAL CONDUCTIVITY MEASUREMENT OF LUNAR SOIL SIMULANTS Wen YU [1], Xiongyao LI [1], ShiJie WANG [2], [1]Lunar and Planetary Science Research Center, Institute of Geochemistry, Chinese Academy, Guiyang 550081, China, [2]State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry, Chinese Academy, Guiyang 550081, China

Introduction: The significance of studies on thermal conductivity of lunar regolith was realized by American researchers at the start of lunar exploration in 1960s[1-3]. Thermal conductivity of lunar regolith was supposed to reflect the composition, structure and even the origin of moon. Studying thermal conductivity of lunar regolith could also (1) provide the key parameter which is used to interpret thermal infrared and microwave data[4-6]; (2) help to answer some questions about thermal evolution of moon such as sub-surface temperature and inner heat flux[7-8]. In addition, considering the complex thermal environment on the surface of moon, knowledge on thermal conductivity of lunar regolith will help to design the lander of the lunar explorer.

Introduction of instrument: To simulate the environment of lunar surface, a vacuum freeze dryer has been assembled with the thermal conductance meter (Hot Disk TPS2500S). By setting up a vacuum controller and a new sample pool, thermal conductivity can be measured at variable temperature and vacuum degree (Fig. 1).

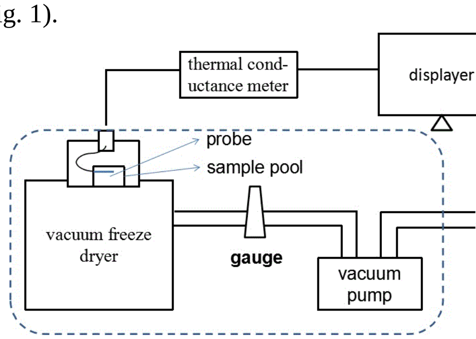

Fig. 1 The structure diagram of Hot Disk TPS2500S after modification

Thermal conductivity Measurement: Because we don’t have lunar soil, we use the simulated lunar soil as the experimental sample for the thermal conductivity measurement. The experimental results show, 1) thermal conductivity of simulated lunar soil decrease with lower vacuum degree. There is an apparent change of heat conduction mechanism when vacuum degree is around 1000Pa. Under low vacuum degree condition, thermal conductivity changes slowly with atmospheric pressure. 2) Thermal conductivity of simulated lunar soil increase with temperature, but in different ways between low and normal atmospheric pressure conditions. Here we could use the equations fitted by experimental data in Figs. 2 and 3 to extrapolate the thermal conductivity of lunar soil on the surface of moon with the temperature range of 90K~400K and atmospheric pressure lower than 1 Pa.

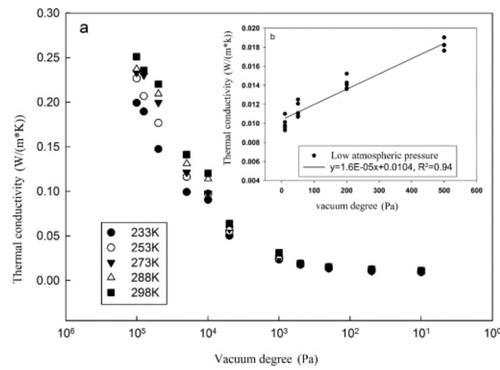

Fig.2 (a) Plot of thermal conductivity versus vacuum degree for simulated lunar soil ; (b) The relationship of thermal conductivity of simulated lunar soil and vacuum degree under low pressure condition (<1000Pa). The solid line is the linear regression line of those data.

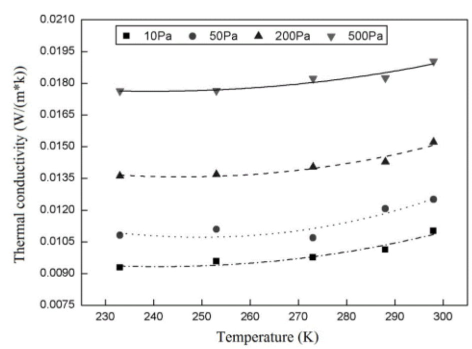

Fig.3 Plot of thermal conductivity versus temperature for simulated lunar soil under low pressure condition (<1000Pa)

Summary and perspective: Laboratory studies on thermal conductivities of simulated lunar soil under vacuum condition can provide essential parameters when determining thermal properties and thermal evolution on lunar and planet surface, interpreting microwave and thermal infrared data and designing lunar explorer. Using modified thermal conductivity measuring instrument (HOT DISK TPS 2500S simulated lunar soil samples are measured for their thermal conductivities under various vacuum degree and temperature conditions. By doing this, we evaluate the effects of vacuum degree and temperature on thermal conductivity of simulated lunar soil . The experimental results show, 1) thermal conductivity of simulated lunar soil decrease with lower vacuum degree. There is an apparent change of heat conduction mechanism when vacuum degree is around 1000Pa. Under low vacuum degree condition, thermal conductivity changes slowly with atmospheric pressure. 2) Thermal conductivity of simulated lunar soil increase with temperature, but in different ways between low and normal atmospheric pressure conditions. With the experimental data, quantitative relationships of thermal conductivity of simulated lunar soil and vacuum.

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