MULTI-BAND POLARIMETRY OF LUNAR REGOLITH MATERIALS IN LABORATORY

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Abstract:

To understand the polarization characteristics of the lunar regilith, we have carried out multi-band (B, V and R passbands) polarimetric measurements. Fe2O3 powders that is found in the lunar regolith and JSC-1A, the lunar soil simulant, were considered.

Although numerous laboratory measurements have dealt with powdered volcanogenic products and chemicals (e.g., [1-3]), their laboratory environments such as the preparation methods of the materials, observing wavelengths, the light source simulating the sunlight are quite different from each other. In this work, we carried out multi-band polarimetric measurements of five materials in a consistent way.

Laboratory Measurements:

Figure 1 shows an optical scheme of the device, Powdered sample was placed on a black tray between the lighting unit and the imaging unit. The phase angle (i.e. the angle lamp–sample–camera) is acquired by adjusting the positions of the lighting unit and the imaging unit keeping a fixed 110cm distance to both directions. A 3800K white lamp and a depolarizer compose the lighting unit. The imaging unit, CCD camera, color filter set and polarization filter are identical to those used in the ground-based observations on the moon by [4].

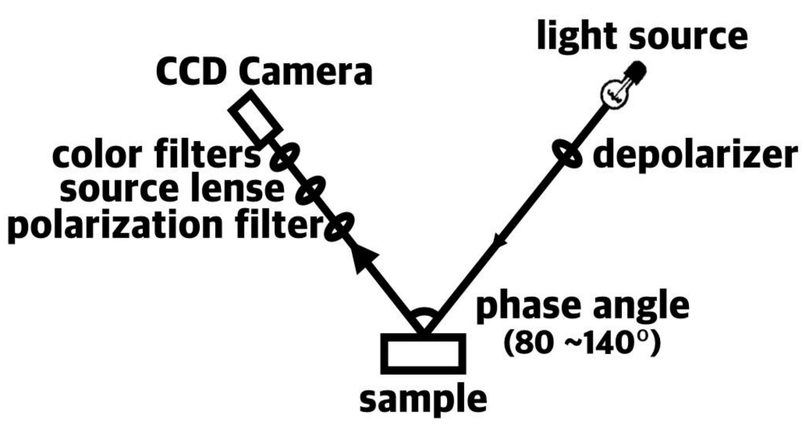

Figure 1. The optical scheme of laboratory polarimetry apparatus.

Polarization Curves:

We prepared Fe_2O_3 powder which compose a large percentage of the lunar regolith, the lunar soil simulant JSC-1 and size-sieved silicon carbide (SiC) in three different sizes ranging from 12.7 μm to 127 μm.

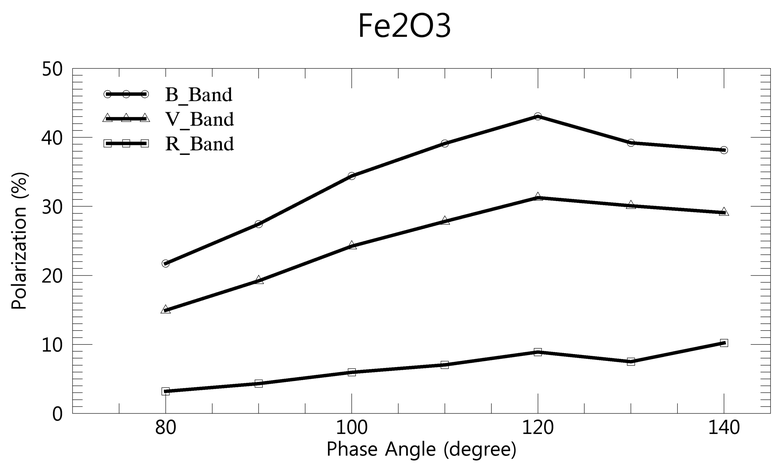

Figure 2. Polarization degree versus phase angle for Fe_2O_3 powders.

Figure 2. shows polarization degree versus phase angle for Fe_2O_3. Referring to Figure 2, phase angle of maximum polarization is 120° and polarization degree of Fe_2O_3 is higher than JSC-1A and ground-based observations on the moon.

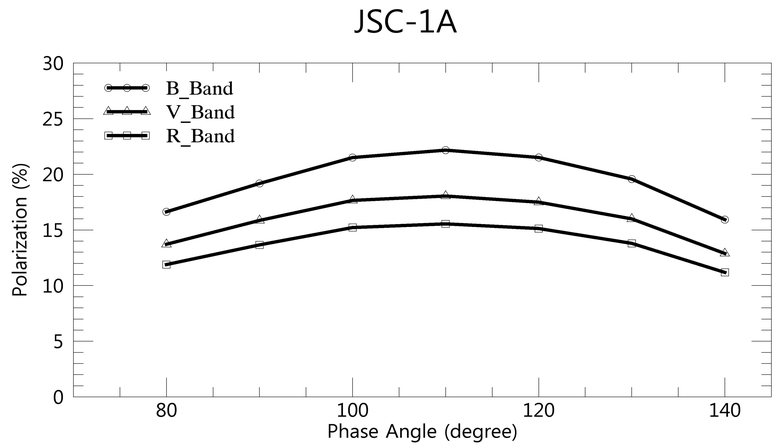

Figure 3. Polarization degree versus phase angle for lunar simulant JSC-1A

Polarization curves of JSC-1A and ground-based observation on the moon by [4] are very similar. Figure 2. shows polarization degree versus phase angle for JSC-1A and maximum polarization phase angle is 110°.

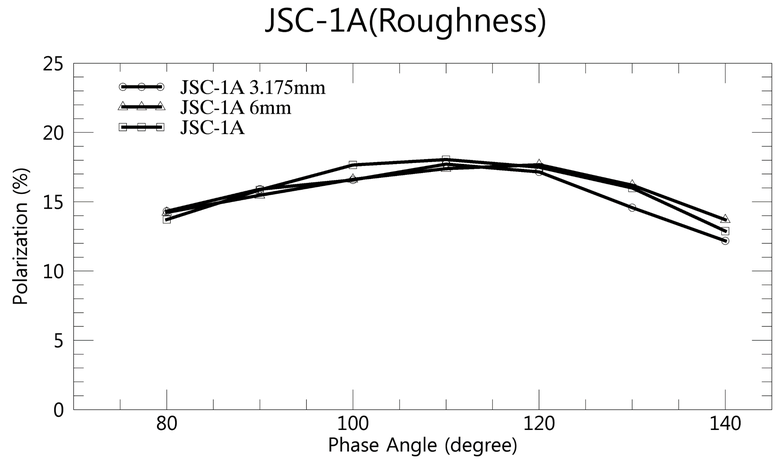

Figure 4. V-band polarization curves of three different surfaces.

In the other experiment we investigated the effect of the surface roughness on the polarization degree. We made some groove on surface of JSC-1A with 3.175mm and 6mm sticks and results are shown in Figure 4.

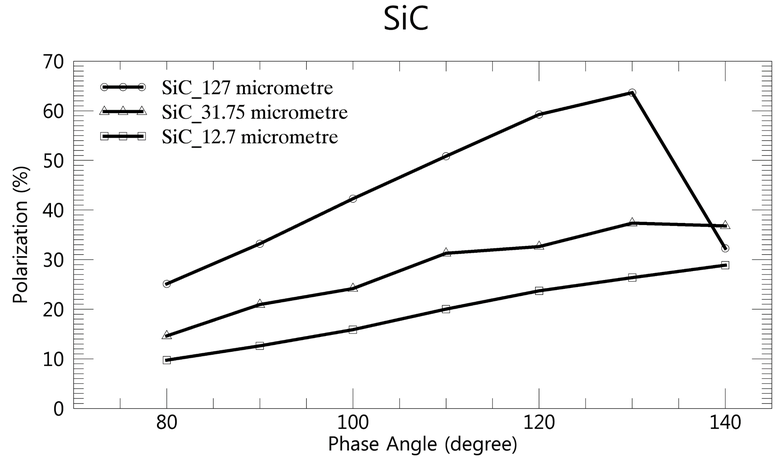

Figure 5. Polarization degree versus phase angle for SiC with different particle sizes.

We also carried out same measurement for different sizes of particles from 12.7μm to 127μm. As the previous studies (e.g., [5-6]), we verified that the smaller particle size make the lower polarization degree.

We'll build the database what can influence on polarization degree such as the size of particles, specimens, and so on.

References:

[1] Clarke, D. (1965) *MNRAS, 130, 83C.* [2] Coffeen, D. L. (1965), *AJ. 70, 403-413*. [3] Pellicori, S. F. (1969) *AJ, 74, 1077-1072*. [4] Jeong, M. (2015) *this workshop*, [5] Egan, W. G. *JGR, 72, 3233-3245*. [6] Shkuratov, Yu, G. (1992), *ICARUS, 99, 468-484*.