TOTAL ELECTRON YIELDS AND TOTAL FLUORESCENCE YIELDS OF ALBITE AND LUNAR SOIL SIMULANTS JCS-1 AND MLS-1; C. Y. Robert Wu, Fangzhong Chen and D. L. Judge, Space Sciences Center, University of Southern California, Los Angeles, California, 90089-1341, and K. Tan, Canadian Synchrotron Radiation Facility, University of Wisconsin, Stoughton, Wisconsin, 53589-3097.

The temporal and spatial distributions of the tenuous Na and K atmospheres of the Moon have inspired exciting discussion during the past few years. Perhaps the two most striking observational facts are: the non-uniform and unsymmetrical global distribution of Na and the departure of the temperature of the Na atmosphere from that of the lunar surface. Many theories have been offered to interpret the observational results but none of them provides a satisfactory solution. This is simply because we don't have the required fundamental data regarding the photodesorption/photon sputtering yields of Na and K, the Na- and K-surface interaction rates, and the Na and K diffusion rates in the lunar materials. To provide much of the required data we have initiated a laboratory program to systematically study the photon desorption processes and the gas-surface interaction processes. In this paper we report our preliminary study of the total electron yields (TEY) and total fluorescence yields (TFY) of albite and two lunar soil simulants, MLS-1 and JCS-1, in the ultraviolet-extreme ultraviolet region.

The lunar soil simulant MLS-1 is derived from a high-titanium basalt hornfels which approximates the chemical composition of Apollo 11 soil [1] while the JCS-1 approximates a low-titanium mare soil and contains a high percentage of glass [2]. The albite used in this study is a gray-pink rock showing good cleavage. It is a common rock on Earth and is thought to exist in the pristine lunar surface. The particle size distributions of the samples used in this study are typically less than 100 um. Other relevant lunar materials will be studied in the future as the need arises.

The measurements were carried out at the Synchrotron Radiation Center, University of Wisconsin. The experimental set up employed in the present measurements has been described previously [3,4]. The TEY spectra of albite, JCS-1, and MLS-1 in the 68-78 eV region are shown in Fig. 1. The structures in this photon energy region are mainly due to aluminum-containing compounds. Almost identical features are observed in the albite and JCS-2 samples, whereas extra features, Br-containing compounds at 70.8 eV and sapphire at 78.5 eV [5], are observed only in the MLS-1 sample.

In Figs. 2 and 3 we show the respective TEY and TFY results of silicon-containing compounds in the 96-120 eV region. The three samples exhibit similar gross features with peaks at 107.8 and 115 eV which are due to the shape resonance of silicon oxides. The elemental Si doublets at 105 and 105.8 eV can clearly be seen in the TEY spectrum of albite but not in the samples of JCS-1 and MLS-1. Both lunar soil simulants show a weak feature at 101.6 eV which is not observable in the albite TEY spectrum. However, the TFY spectra of the three samples are quite similar to each other, as may be seen in Fig. 3.

In this initial work we have only obtained relative yields of total electron and total fluorescence from photon excitation of the three samples. The absolute yield measurements are currently in progress. In the next phase of our research program we shall study the interactions between Na and albite, JCS-1, and MLS-1. Photon energies in the 6-120 eV region will be used in order to cover all prominent UV-VUV solar lines. The excitation of Na and K will be accessible throughout this photon energy region. The 6 to 10 eV photons will allow us to probe valence and inner valence electronic states of lunar related Na and K compounds which are of particular interest in the study of gas-surface interactions.

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Total Electron Yields and Total: Wu et al.