SPACE WEATHERING EFFECTS AT THE SURFACE OF THIN-FILM ALUMINOSILICATE MODEL REGOLITH. Bijoya Dhar and William E. Kaden, University of Central Florida, Department of Physics (dhar.bijoya@knights.ucf.edu, william.kaden@ucf.edu).

The proper understanding and predictions of radiation effects on airless bodies' regolith are necessary for safe and sound human exploration in Moon, Mars, Mercury, and near Earth asteroids (NEAs). Numerous studies reported the presence of hydroxyl (OH) upon H^+ irradiation on natural/man-made terrestrial minerals, as well as, simple volatiles, like, methane (CH_4) and water (H_2O) on lunar surface. In addition to these reports, information from major space missions help to understand the radiation impact on airless bodies. But, a detail study about lunar and NEAs chemical and volatile composition and radiation processing of lunar/NEAs regolith is still needed to understand the fundamental physics and chemistry behind the regolith transformation, volatile formation and sequestration, which will facilitate future human mission on airless bodies within the solar system and will also help to compare with the regolith samples obtained from sample returned missions. Our approach towards space weathering effects on model regolith research is integrated though the different sources of energetic radiation, with particular attention to the solar wind and micrometeorite bombardment impact on nature or man-made regolith.

Herein we use aluminosilicate sheets as model regolith. Experiments are conducted within a multi-purpose ultrahigh vacuum (UHV) system, which is used to generate the aluminosilicate thin film on ruthenium (Ru) substrate. Techniques such as X-ray photoelectron spectroscopy (XPS), ion source spectroscopy (ISS), low energy electron diffraction (LEED), and scanning tunneling microscopy (STM) are employed to characterize the thin film. At first Ru is cleaned with several cycles of Ar^+-sputtering/annealing; cleanliness is confirmed by contaminant-free XPS spectra and sharp (1x1) hexagonal LEED pattern of Ru. Silicon (Si) and aluminium (Al) metal atoms are then deposited subsequently on Ru via electron beam evaporation (EBE) technique, followed by thermal crystallization within oxygen environment to generate planer, crystalline silica (SiO_2) and aluminosilicate ($Al_xSi_yO_z$) films. The elemental composition/ratio of Si, Ru and O within the film and the film thickness are obtained by XPS, which is supported by ISS method. ISS also provides the qualitative ratio of these elements on the surface. LEED shows both crystalline and vitreous domains of the film at different stages of film generation, whereas these domains are studied at atomic-scale by STM.

Next step will be the observation of micrometeorite bombardment and solar wind processing of the regolith simulant, i.e. the $Al_xSi_yO_z$ sheets using the irradiation facilities available in our lab. Radiation assisted changes in the film will be investigated with and without volatiles, like, H_2O and CH_4, using temperature programmed desorption (TPD), atomic force microscopy (AFM), secondary ion mass spectroscopy (SIMS) and electrostatic force microscopy (EFM) techniques. Our methods encompass a wide range of surface science experimental methodologies for investigating the non-thermal radiation impact on lunar/NEAs regolith samples by characterizing the regolith simulant at different states to have a better understanding about the evolution of volatiles. Through this approach, gaps in knowledge related to radiation processing and space weathering effects on the airless bodies are clearly identified.