Auger Electron and X-ray Spectroscopy (AugeX) for in Situ Exploration of Planetary Surface

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Chemical composition of a planet holds clues to its formation process and its subsequent evolution. Chemical analysis by in situ probes will thus improve our understanding of the origin and evolution of the planets. A non destructive probe on a rover will be ideal to achieve this objective. We propose to develop an instrument for determining the chemical composition of the planetary surface through in situ measurements on the planetary surface, along the rover traverse. The instrument (AugeX) consists of two simultaneously operating spectrometers namely an Auger electron spectrometer and an X-ray spectrometer and a radioactive source for exciting sample.

The working principle of AugeX instrument is the irradiation of the sample surface with alpha particles and X-rays from the radioactive source ^{244}Cm. Low *Z* elements will be primarily detected by alpha particle induced X-ray emission (PIXE) and Auger emission (AES), while high *Z* elements will be primarily detected by X-ray fluorescence (XRF). PIXE and XRF are well proven techniques with space heritage and Auger Electron Spectroscopy (AES), a well tested laboratory technique is being proposed for a planetary surface exploration for the first time. The X-ray spectrometer will use Silicon Drift Detector (SDD) for detecting characteristic X-rays with energy resolution of about 150 eV at 5.9 keV in the energy region 1-16 keV. Auger electron spectrometer will use Cylindrical Retarded Potential Analyzer (CRPA) for detecting the Auger electrons with energy resolution of about 1 eV at 200 eV over the energy range 0.1 – 2 keV.

The instrument consists of a sensor head and an electronics package. The sensor head contains 6 radioactive sources with total activity of ~30 mCi, an X-ray detector (SDD) and CRPA. The placement of the sources and the sensors will ensure to cover approximately the same area of the sample surface. SDD to be used in the experiment will have ~20 mm^2 active area with a covering of ~8 micron thick Be window to protect it from contamination. The AES will use a CRPA with a 25 mm diameter channeltron detector. All radioactive sources will also be covered with 2 micron thick titanium foils to prevent cross contamination of the sample and the source. The front face of the AugeX sensor head will have a shutter to protect the sensors and sources from the planetary dust contamination. The inner face of the door will have an appropriate coating, which will serve as a calibration source.

Each detector has its own HV bias unit and preamplifier. In case of X-ray spectrometer, the spectral data will be directly available via pulse height analysis, followed by A/D conversion, while in the case Auger electron spectrometer, pulse counting in conjunction with a retarding voltage scan will yield a pass curve, which can be later analysed to obtain a spectrum. The design aspects of the engineering

model of the instrument and the calibration results of the respective detectors will be discussed in the meeting.