Calibration of a μ-XRF prototype instrument used in modelling the performance of the Planetary Instrument for X-Ray Lithochemistry (PIXL) for Mars 2020

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Efforts directed towards calibrating the Planetary Instrument for X-Ray Lithochemistry (PIXL), selected for the Mars 2020 rover mission, have commenced. Unique to this generation of X-ray fluorescence instruments for planetary missions is the capability to perform two-dimensional elemental mapping of rocks and soils. PIXL will also be used to perform quantitative analysis of major, minor and trace elements in μm-mm scale rock components.

Preliminary work to calibrate for elemental analysis was carried out using a prototype instrument setup as a means to better characterize basic operational parameters and capabilities of the flight instrument. The prototype μ-XRF system includes a Rh x-ray tube (manufactured by Moxtek), a polycapillary optic (approximate 95 μm maximum spot diameter at 8 keV, manufactured by XOS) and two silicon drift detectors (manufactured by Ketek). Spectral analysis was performed using in-house fitting software (PIQUANT) that processes data using a fundamental parameters approach with element specific correction factors derived from measurements performed on homogeneous standards.

We will present an overview of the flight instrument design and the experimental setup of the prototype system. A sample of the results from measurements of major, minor and trace elements found in standards will be presented, demonstrating the detection limits and accuracy levels expected from the flight instrument. Challenges associated with the calibration process will be discussed, including for example: quantification of low levels of P, S and Cl when interference from the Ca Ka escape peak, Ti Ka escape peak and the combined Ar K and Rh L lines, respectively, dominate over the former in peak intensity.