Miniature ICPMS for in situ chemical analysis: Applications for landed lunar science

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Determining the abundance and distribution of trace elements and radiometric ages of in situ Lunar samples may hold the key to unlocking the Moon's secrets. New developments in Inductively coupled plasma mass spectrometry (ICPMS), a common technique for measuring trace elements in geologic material, show that a low power, low pressure plasmas can effectively ionize input geologic material. Here, we report on our development of a prototype miniature ICPMS and demonstrate its capabilities using an innovative plasma source that requires only a fraction of the forward power and gas flow of a commercial system. We discuss using this technology, specifically with applications to a hypothetical in situ landed mission to the lunar farside. Measuring low abundance trace elements can help us understand the asymmetric distribution of heat producing elements early in the Moon's history, and mantle mineralogy. We carried out a landing site analyses of specific lunar farside targets based on crustal thickness, crater floor mineralogy, and mare basalt emplacement. We have identified four craters that could maximize the science return for a landed mission using this technology.

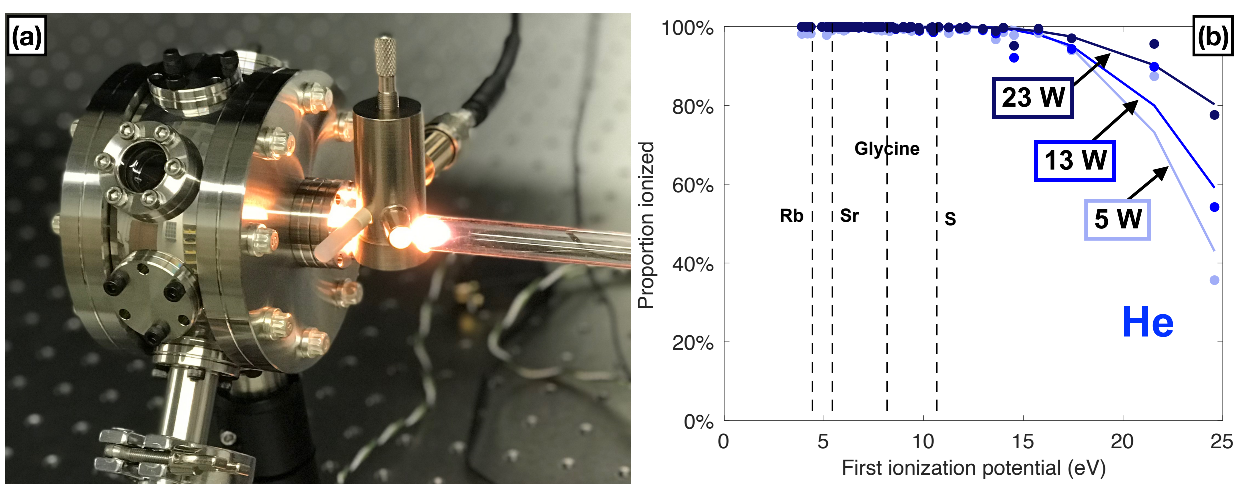

Fig. 1. (a) Photo of a low power He plasma source, generated with 14 W of power and 200 mL min^{-1} gas, developed at the University of Maryland. (b) Estimated ionization efficiency of low power He plasma based on the Saha equation. This plasma can ionize elements with high ionization potential (e.g. S, 10.4 eV) with as little as 5 W of power.