Miniaturized Raman/LIBS instrument for in situ planetary exploration

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In our solar system, there is a multitude of planetary bodies without substantial atmospheres, including asteroids, comets, moons, and minor planets. Due to their lack of atmospheres, these bodies are not affected by atmospheric alteration processes. Asteroids and comets especially are considered to be least evolved objects in the solar system, possibly even still containing pre-solar grains from the proto-solar nebula [1]. Therefore, the study of planetary objects without atmospheres can yield important information about the formation of the solar system. This makes them interesting targets for robotic exploration with instruments that are able to determine the chemical composition of both their surface and subsurface.

We present first results of the design and characterization of a miniaturized instrument for the application on planetary bodies with low or non-existent atmospheric pressure. The instrument will combine Raman spectroscopy and laser-induced breakdown spectroscopy (LIBS), similar to the SuperCam instrument planned for the Mars2020 mission [2, 3]. The combination of these two complementary measurement techniques increases the amount of information that can be gathered from a sample, with Raman spectroscopy providing information about molecular structures in the sample, and LIBS providing supplementary information about the elemental composition. Both techniques can be used from a distance and require no sample preparation. In contrast to SuperCam, the proposed instrument is not optimized for stand-off distances of up to 12 m, but is intended for a close-up configuration of ~1 m distance to the target. This reduces the weight of the instrument, as it removes the need for a telescopic system and allows for the employment of a less powerful laser. With an estimated total weight of ~3 kg, the proposed instrument is very lightweight and well-suited for small landers. Miniaturized components and first results from performance tests are presented.

References:

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