Automated quantitative LIBS using artificial neural network algorithm

Motto-Ros, V.; Koujelev, A.; Dudelzak, A.; Osinski, G.; Sabsabi, M.; Laville, S.

Automated quantitative LIBS using artificial neural network algorithm

V. Motto-Ros[1], A. Koujelev[1], A. Dudelzak[1], G. Osinski[1], M. Sabsabi[2], S. Laville[2]

1 Canadian Space Agency, 6767 route de l'Aéroport, Saint-Hubert QC Canada J3Y 8Y9
[2] Industrial Materials Institute National Research Council, 75 de Mortagne Blvd, Boucherville QC Canada J4B 6Y4

Laser-induced breakdown spectroscopy (LIBS) has emerged during the last decade as a reliable analytical technique and has been demonstrated for elemental analysis in many fields including geology, metallurgy, pharmaceutical industry, homeland security, forensic , environment or as tool for scientific research . In particular, LIBS is considered a very promising technique for future landing planetary, asteroid or comet exploration missions. For these space exploration applications it would be very desirable that the instrument could provide fully autonomous, real-time, quantitative identification of major elements and mineral matrices of interest. In this work, we demonstrate, using an artificial neural network (ANN) algorithm, both the sample identification and the automated real-time quantitative measurements of a group of major elements of planetological interest.

The long-term target of our work is to prototype a miniature (low mass, volume, and power consumption) instrument that would allow automated measurements of elemental composition of planetary (e.g. Martian) surface. Identification and quantitative analysis of LIBS spectra is made using ANN algorithm trained with a set of reference samples. Measurements have been done on various samples including aluminum alloys, standard terrestrial soils and rocks, as well as samples collected on meteorite impact sites. In all cases, the accuracy of measured concentrations was in the range of 10% for almost all the elements studied in our conditions as compared to calibration values. The results demonstrate the analytical capability of our-developed ANN algorithm and its promising potential for the above-mentioned applications.