PROGRAM 2:
SEPARATE

LIBS analysis for geo-sensing

PROJECT P2-004

Proof of concept study for development of combined LIBS-Mid-IR QCL as an industrialised elemental and mineralogical analyser for scanning coarse rock streams.

This project seeks to develop a novel application combining Laser Induced Breakdown Spectroscopy (LIBS) and Mid-Infrared (Mid-IR) Quantum Cascade Laser (QCL) aiming at a rapid on-line elemental and mineralogical characterisation of ores suitable for deployment on mine sites in a variety of settings from in-pit muck piles, underground draw points, cross-belt scanning and on-line slurries.

Research collaboration

NRC has extensive knowledge in LIBS technology, and its successful implementation in several commercial applications such as agriculture, mining, automotive, aerospace, security and pharmaceuticals. Extensive experience of the physics, technical issues, hardware and software generated from previous and on-going development (analysis of soil, oil sands, molten materials, slurries and gold ore samples) can be brought to bear on new minerals applications with a focus on Grade Engineering® support through collaboration with CRC ORE.

While LIBS generates qualitative to quantitative elemental spectra, the challenge in the current project is to convert these spectra to mineralogical signatures.

Industrialisation and commercialisation of a field deployable large array LIBS system designed to provide on-line mineralogy would be of direct interest to a wide range of METS that currently provide Geo-sensing capabilities and hardware.

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Project Leader:	Alain Blouin, NRC
Timing:	April 2017 – March 2019
Participants:	NRC, CRC ORE

Image: Portable LIBS system for mineral sample measurements. Supplied by NRC.

Background & aims

LIBS and Mid-IR QCL technology have many desirable features for use as an on-line sensor on coarse rock materials. Chief amongst them is the ability to generate spectral data at remote distances (>several metres)and small spot sizes (<50 microns). LIBS is able to analyse low atomic number elements (eg. C, Na, F) and to achieve very low detection levels of ppm, and is supported by the increasing and low cost ownership of fibre optic lasers.

This project aims to combine recent advances in LIBS and Mid-IR QCL hardware and evaluate the opportunity to create a novel LIBS-Mid-IR QCL application based on mineralogical discrimination supported by elemental information. In addition, the approach will be combined with the use of advanced chemometrics tools that NRC has developed over the years for other applications such as oil sands, gold ore and soil analysis.

Focus on outcomes

- Demonstration of capability of LIBS to meet industrial process criteria such as 'shock clean' surfaces coated with a thin film of water, mud and fines.
- Establish sampling theory and statistics in collaboration with CRC ORE.
- Generate representative LIBS and Mid-IR QCL spectra for defined mineral species using existing reference samples previously characterised using SEM and other techniques.
- Identify potential deployment opportunities for this technology throughout a Techno-Economic Analysis (TEA) and generate a business case in collaboration with CRC-ORE IDG.
- Evaluation of lab-scale scanning and repetition rates using fibre lasers and optical focussing systems to determine spatial coverages for scale up.
- Investigation of data reduction methodologies and software requirements to reduce LIBS and Mid-IR QCL spectra to mineral speciation using pattern matching techniques, specification of algorithms, and chemometrics models required to deliver classification at production scale in software.

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