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Development of Laser-Induced Breakdown Spectroscopy Technologies for Nuclear Safeguards and Forensic Applications

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Under the IAEA Task A1855, the Canadian Safeguards Support Program (CSSP) undertook the development of laser-induced breakdown spectroscopy (LIBS) technologies for safeguards applications. Collaboration between the Canadian Nuclear Safety Commission (CNSC), the National Research Council Canada, and the IAEA has demonstrated that the LIBS technique combined with chemometrics can determine the origins of yellowcake, identify maraging steels, aluminum alloys, and magnesium alloys, among other materials involved in the nuclear industry; and determine heavy water content as well as the isotope ratios of other actinides. As part of the task, the CSSP has developed a portable LIBS system to enable inspectors to characterize specific nuclear and non-nuclear material during complementary access and inspections. This device was recently tested by the IAEA in both Vienna and Siebersdorf for various metals and uranium bearing materials. The laser source proved to be stable and the chemometrics software was able to identify various materials. The device is ready for further in-depth testing.

The chemometrics algorithm that has been developed for LIBS can also be adapted to nuclear forensics for the querying database. Multi-stage pattern recognition algorithms can reliably identify unknown materials among database populations (e.g. identify origins of yellowcake). Further work in this field is being undertaken as part of the CNSC's National Nuclear Forensics Library (NNFL) development activities for the Canadian National Nuclear Forensics Capability Project (CNNFCP).

The paper will provide an overview of the LIBS techniques being developed for safeguards and forensic applications, and of progress in integrating all components into a compact unit.

Country or International Organization

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