

Quantum Cascade Laser Mid-Infrared Spectroscopy for Online Monitoring of Aqueous Chemical Processing

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Technology Summary

This invention disclosure describes a new approach for high sensitivity and real-time online measurements to monitor the kinetics in the processing of nuclear materials and other chemical reactions. Mid infrared (Mid-IR) quantum cascade laser (QCL) high-resolution spectroscopy will be used for rapid and continuous sampling of aqueous and organic reactive systems, using pattern recognition analysis and high sensitivity to detect and identify chemical species. The method selected to perform these online measurements has been demonstrated by ORNL as a standoff technique with the capability for trace chemical detection and identification of surface residues and environmental gases with high sensitivity and selectivity. The innovation comes from demonstration of the capability of the Mid-IR QCL spectroscopy for the first time in the detection and identification of ongoing chemical processes in aqueous and organic solution. Unlike current analytical methods, in this standoff or off-set method, the collection of a sample for analysis is not required. To perform the analysis, a flow cell was used for in situ sampling of a liquid slipstream. A prototype has been designed based on attenuated total reflection (ATR) coupled with the QCL beam to detect and identify chemical changes and be deployed in hostile environments, radiological or chemical. The target nitrate/nitrite analysis related to the separation of Np and Pu for Pu-238 production to be demonstrated in this project, could be also useful for environmental monitoring, processing of biomaterials, and Department of Homeland Security applications.

Inventor

MORALES RODRIGUEZ, MARISSA E
Energy & Transportation Science Division

Licensing Contact

SIMS, DAVID L
UT-Battelle, LLC
Oak Ridge National Laboratory
Rm 124C, Bldg 4500N6196
1 Bethel Valley Road
Oak Ridge, TN 37831

Office Phone: (865) 241-3808

E-Mail: SIMSDL@ORNL.GOV