

TECHBRIEF

PORTABLE LUMINESCENCE-BASED SENSOR FOR RARE EARTH ELEMENT DETECTION

OPPORTUNITY:

Researchers at the U.S. Department of Energy's National Energy Technology Laboratory (NETL) have developed a portable, luminescence-based, fiber optic sensor for the detection and quantification of rare earth elements (REEs) in coal by-product and other industrial process waste streams. The device provides rapid results, with a lower limit of detection in the parts per-billion range. The rapid response time provided by the device can save the end user costs associated with inactivity during recovery or mining operations while potentially allowing for in-line monitoring or rapid field sampling. The technology is available for licensing and/or further collaborative research.

OVERVIEW:

Rare earth elements (REEs) serve as essential components of many technologies spanning a range of applications, including electronics, computer and communication systems, transportation, health care, and national defense. REEs exist in relatively low concentrations and require further processing for mining and extraction, which is technically and economically challenging. Nevertheless, the demand for REEs continues to grow. This has created a need for economically-feasible approaches for REE recovery from nontraditional sources such as coal waste streams.

Recovery of REEs from coal and other industrial waste streams necessitates an efficient method of determining whether the REEs exist at concentrations sufficient to warrant their separation and recycling. Conventional REE screening methods such as inductively coupled plasma-mass spectrometry (ICP-MS) are expensive, time-consuming, and immobile. A sensitive, affordable, compact, and field-ready option for REE detection is thus needed.

NETL researchers have developed a portable luminescence-based fiber optic sensor for the detection and quantification of REEs in coal by-product waste streams. The device can detect $\mu\text{g/L}$ (part-per billion) concentrations of terbium, europium, dysprosium, and samarium in aqueous solution. Luminescence sensitizers allow for the quantification of additional REEs. Significantly, the sensor has a footprint of less than 1m^2 and can deliver results in the field within one minute, orders of magnitude faster than sending samples to a lab., at a fraction of the cost of an ICP-MS system.





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SIGNIFICANCE:

- The sensing device is more mobile, faster, and affordable than conventional detection systems
- The sensor is capable of detecting REEs in the parts per-million to parts per-billion range
- Luminescence sensitizers can be incorporated to improve detection limits
- Use does not require extensive operator expertise, maintenance or high amounts of consumables

APPLICATIONS:

- Detection of low concentrations of REEs in aqueous coal by-product waste stream
- Monitoring of electronic waste streams from landfills and other industrial recycling sources

PATENT STATUS:

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Title: Luminescence Based Fiber Optic Probe for the Detection of Rare Earth Elements

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