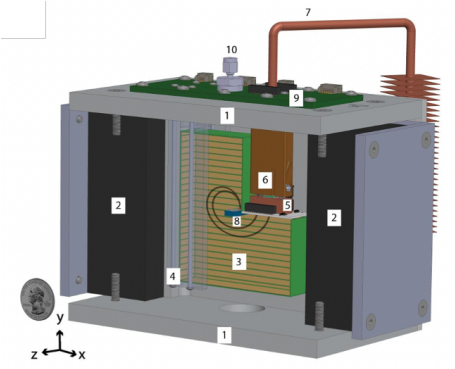

Portable mass spectrometer with high sensitivity and resolution

Unmet Need

Mass spectrometry is a method of particle composition analysis. Traditionally, mass spectrometers are large devices with high energy requirements, restricting them to high-resource laboratory settings. Mass spectrometry can be used for isotopic analysis of nuclear material, environmental testing, biological aerosol analysis, and other forms of particle analysis that occur in remote locations, away from the lab. The process of collecting samples at remote test sites and sending them back to the lab for testing is costly and requires additional resources and time. There is a need for an improved method of mass spectrometry for remote testing sites to improve throughput and quality of analysis, without sacrificing performance due to the use of a smaller, portable mass spectrometer.

Technology

Duke inventors have developed a portable cycloidal mass spectrometer with high resolution and sensitivity. Cycloidal spectrometers have an advantage over other types of mass spectrometers because focusing on the sample relies on the mass and charge of ions that are analyzed, rather than the direction or velocity that the ions enter the spectrometer. Despite the powerful analytical abilities of cycloidal spectrometers, they have previously not been available as portable devices. Specifically, this portable cycloidal mass spectrometer leverages recent advances in ion array technology and the use of a virtual slit to maintain high performance in particle analysis, including high sensitivity, resolution, dynamic range, and ratio accuracy, while providing user-friendly features such as being easy to use and portable. This is intended to be used to analyze particle composition at remote sites, such as low-resource environments or nuclear energy facilities. The authors have demonstrated the effectiveness of this technology via successful computer simulations of the trajectory of the ions of various energy ranges traveling from the sample to the detector array on the device, as well as a physical prototype that demonstrates high sensitivity of composition analysis while maintaining a small physical footprint.

Other Applications

This technology has wide-reaching industrial applications in atmospheric aerosol analysis, explosive trace detection, drug discovery, industrial particulate analysis, food and beverage testing, and environmental testing, as well as studying biological aerosols, metabolomics, proteomics, and geology.

Advantages

- Easy to use with high sensitivity, high resolution results, and large dynamic range
- Ideal for remote testing applications – the portability of the device means it can be used on site, rather than collecting samples and sending them back to the lab
- Leverages virtual slit technology to allow for smaller device without loss of performance

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Publication(s)

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External Link(s)

• From the lab of Dr. Jason Amsden
• ARPA-E Supports Miniaturized Mass Spectrometer Project at Duke (Pratt School of Engineering, 2015)