BENT CRYSTAL SPECTROMETER FOR PEBBLE BED REACTOR BURNUP MEASUREMENT

Tech ID: 33914 / UC Case 2025-087-0

PATENT STATUS

Patent Pending

BRIEF DESCRIPTION

Pebble bed reactors (PBRs) are an emerging advanced nuclear reactor design where fuel pebbles constantly circulate through the core, as opposed to housing static fuel assemblies, generating numerous advantages including the ability for online refueling versus expensive shutdowns. Online refueling is overall beneficial but poses an operation challenge in that the pebbles must be measured and analyzed for burnup characteristics very quickly (in under 40 seconds), without much time to cool down, challenging the high Purity Germanium (HPGe) detectors historically used for burnup measurements. HPGe detectors can normally only be operated up to tens of thousands of counts per second, far below radiation rates from freshly discharged fuel, and are therefore operated at large distances from sources, with significant shielding. Only a small fraction of detected counts comes from burnup markers, yielding high uncertainty, or can be completely masked by effects of Compton scattering within the detectors.

To overcome the challenges of using HGPe detectors to measure burnup in continuously fueled reactors, UC Berkeley researchers have developed a novel technology capable of measuring gamma rays within a fine energy ranges and without the interference of Compton scattering. The device is also significantly cheaper than HPGe detectors and offers a reduced detector footprint. Nuclides including but not limited to Np-239, Eu-156, and Zr-95 can be measured and analyzed for burnup, path information through the core, and fast and thermal fluence. Furthermore, precise measurement of the Np-239 content provides better data for reactor safeguard purposes. The technology offers meaningful improvements in measurement accuracy, footprint, and cost, for PBRs and other continuously fueled reactors, such as molten salt reactors (MSRs).

SUGGESTED USES

» Rapid burnup measurements in continuously fueled nuclear reactors, e.g., pebble bed (PBR) and molten salt (MSR) reactors

» Nuclear nonproliferation and safeguarding

ADVANTAGES

» Cheaper and smaller footprint measurement of nuclides predicting burnup measurements in continuously fueled reactors

» Rapid measurement technology

» High energy resolution (potentially <0.2 eV) measures typically obscured gamma energies

RELATED MATERIALS

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OTHER INFORMATION

CATEGORIZED AS

» **Energy**

» Other

» **Environment**

» Other

» **Materials & Chemicals**

» Other

» **Security and Defense**

» Other

» **Sensors & Instrumentation**

» Other

» Physical Measurement

» Scientific/Research

RELATED CASES

2025-087-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- High Powered Target Designs For Neutron-Driven Isotope Production
- Simultaneous 225Ac & 18F Production with Standard Medical Cyclotrons

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