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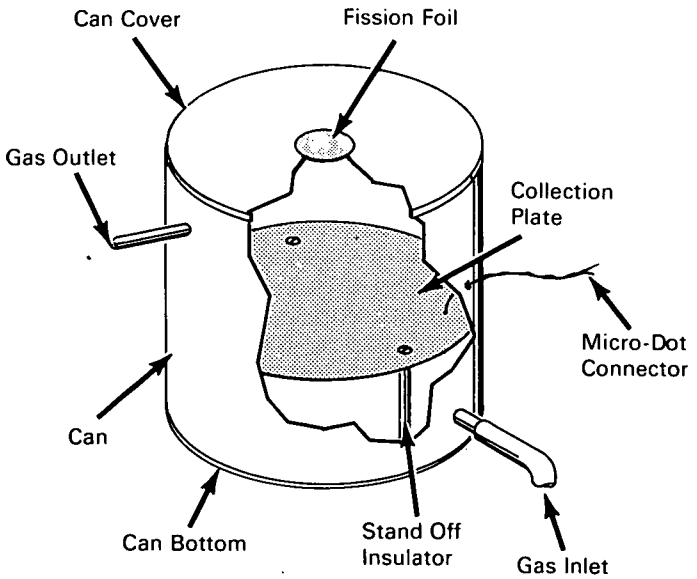
Low Scatter Lightweight Fission Spectrometer Constructed for Biological Research



The problem:

To construct a small, lightweight spectrometer for measuring the absolute neutron flux in a fixed neutron spectrum. Existing units are too massive to substitute for small biological objects suspended in a neutron beam. Studies of fission count rate, as a function of counter mass and composition, have shown that nearly complete elimination of hydrogenous materials and a total mass of less than 200 g are required to avoid undesirable neutron scatter and energy degradation effects.

The solution:

A low scatter, lightweight fission spectrometer provides a simple, reliable and precise method for determining neutron fluxes in a fixed neutron beam. The spectrometer, with a mass less than 120 g, minimizes neutron scatter and energy degradation effects. It has a counting volume large enough to intercept the most energetic fission fragments, yet small enough to provide discrimination against ^{41}Ar and fission-product decays.

How it's done:

The lightweight, low scatter unit is constructed of tinned steel, 0.025 cm thick, combined with Teflon insulators and a 0.15 cm brass or aluminum collection plate. A small can, 10 cm in diameter, provides the shell. The collection plate is located 3.5 cm from the fission foil. Ordinary miniature cable and rubber tubing are used for the gas inlet and outlet.

The unit is normally operated in the ion chamber region using P-10 gas (90% Ar, 10% CH_4) or pure Ar

(continued overleaf)

at a flow rate of approximately 50 cm^3sec^{-1} and a collection plate voltage of +1100 Vdc.

Signals are fed through a linear preamplifier and amplifier into a multi- or single-channel analyzer or into a simple discriminator-scaler with equivalent results. The resolving time of the system is about 1.5 μsec. With this resolving time and alpha and fission count rates up to 1400 sec^{-1}, no alpha pileup is observed. However, if a single foil is used continuously for many hours at higher count rates, a pileup due to ^{41}Ar and fission product decay is detectable. Even this pileup can be eliminated by flow rates in excess of 100 cm^3sec^{-1} or a waiting time of a few hours. The fission foil, usually 100 $\mu g\ cm^{-2}$ or less, is mounted inside the can lid to avoid shadowing by the lid edges.

Spectra from this fission spectrometer compare quite favorably with those obtained from more massive and complex gridded chambers or from solid-state detectors.

Notes:

1. Additional information is contained in *Low Scatter, Lightweight Fission Spectrometer,* by N. A. Frigerio, The Review of Scientific Instruments, vol. 36, no. 7, p. 1048–1049, July 1965.
2. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B68-10174

   Source: N. A. Frigerio
   Biological and Medical Research Division
   (ARG-10094)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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U.S. Atomic Energy Commission
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