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Brief 69-10344

AEC-NASA TECH BRIEF

New Shield for Gamma-Ray Spectrometry

The problem:

Effective shielding of a gamma-ray crystal assembly from background radiation due to cosmic rays or man-made radionuclides, as well as radiation from accelerators or x-ray machines located near the detector. At present this background is reduced by shielding of both the detector and the sample by iron, lead, mercury, or other shielding materials that are essentially free of radioactivity. Such shielding, however, does not eliminate the background component due to airborne radionuclides present within the shield.

The solution:

A gamma-ray shield that can be evacuated, refilled with a "clean" gas, and pressurized for exclusion of airborne radioactive contaminants effectively lowers background noise (*1*). Under working conditions, repeated evacuation and filling procedures have not adversely affected the NaI(Tl) crystal detector; its resolution and sensitivity remain unchanged. The crystal used was jacketed with 3/32-inch stainless steel, and the evacuations were carried out to 0.5 atm. The crystal temperature, inside the shield, comes to a rapid equilibrium after the shield has been evacuated several times and pressurized with carbon dioxide.

How it's done:

The gamma-ray shield consists of a rectangular box measuring (outside) 48 by 42 by 36 inches. The walls, 6 inches thick, are constructed from 2-inch-thick, radioactivity-free, hot-rolled steel plates. The shield is lined with ½-inch lead and 1/16-inch cadmium and copper; this lamination tends to reduce the low-energy continuum and minimizes the effect of x-rays produced in the lead.

The shield's unique feature is that it can be evacuated and filled with any desired gas. To make this possible the box is welded from the outside, and the door has a rubber gasket that seals against a tongue on the door opening. There are three access holes but none has exterior-to-interior straight-line paths. Two serve as filling and evacuation holes; the third provides access for electrical connections to the detector. For low-radioactivity measurements the shield is evacuated and is filled from a pressure tank with a "clean" gas such as carbon dioxide–aged air; it is then pressurized slightly above ambient pressure.

In practice the sample is introduced and the shield's door is closed. The shield is evacuated rapidly to about 0.75 or 0.5 atm, and the door is more firmly secured to the main body by a large threaded bolt that prevents the door from moving back and breaking the seal while the shield is being filled with gas. This procedure is repeated several times so that only a small portion of the original air remains. Since the crystal-jacket temperature changes less than 2°C during this procedure, an experiment can be started 10 minutes later after the shield has come close to equilibrium temperature.

Such a system has operated for more than 2 years with excellent results.

Reference:

1. S. S. Brar, D. M. Nelson, and P. F. Gustafson, *Intern. J. Appl. Radiation Isotopes* **18,** 261 (1967).

Notes:

1. This information may interest gamma-ray spectroscopists.

(continued overleaf)

2. Inquiries may be directed to:

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Argonne National Laboratory
9700 South Cass Avenue
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Reference: B69-10344

Source: S. S. Brar, D. M. Nelson, and P. F. Gustafson
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Patent status:

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

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