NASA TECH BRIEF

Tungsten Thermal Neutron Dosimeter

Tungsten-184 has been found to be a useful dosimeter for thermal neutrons, particularly in high-temperature applications. The reliability of tungsten-184 as a dosimeter has been verified against a standard dosimeter, cobalt-59, in a wide range of temperature and nuclear environments.

Short-term irradiation (< 40 hours) of tungsten-clad, tungsten-uranium dioxide fuel-plate test specimens at high temperatures produced neutron dosimetry problems. The high temperature of the irradiation (1100° to 3300°K) did not allow the use of standard dosimeters, such as the isotopes of cobalt, dysprosium, or gold, to determine the thermal neutron flux because of their relatively low melting points (1768°, 1336°, and 1680°K, respectively, in contrast to the melting point of tungsten, 3683°K). The use of fission products such as cesium-137 or zirconium-95 as a measure of burnup was not reliable, as specimens lost fission products during irradiation. The shorter term irradiations, in some cases four hours or less, did not produce sufficient change in the ratio of uranium-236 to uranium-235 to accurately determine the uranium burnup.

The problem was resolved by using naturally occurring tungsten-184 in the specimen cladding as the thermal neutron flux monitor. Tungsten-185 activity, which is produced by neutron activation of tungsten-184, was used to determine the thermal neutron flux. Radiochemical separation methods and counting techniques for irradiated tungsten were developed concurrently for accurate determination of the radiation exposure.

Notes:

1. The naturally occurring isotope, tungsten-184, has been shown to be an effective thermal neutron flux monitor for high-temperature (1100° to 3300°K) irradiations up to 200 hours.
2. The thermal neutron capture cross section of this isotope was measured to be 1.94 $\pm$ 0.08 barns (95% confidence level).
3. Documentation is available from:
   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10249
4. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B69-10249

Patent status:

No patent action is contemplated by NASA.

Source: L. L. Ball, P. J. Richardson and D. W. Sheibley
Lewis Research Center
(as part of the Nuclear Rocket Program)
(LEW-10880)

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