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AEC-NASA TECH BRIEF

Aluminum–Titanium Hydride–Boron Carbide Composite Provides Lightweight Neutron Shield Material

The problem:

To develop inexpensive lightweight neutron shield materials having high strength and ductility and capable of withstanding high internal heat generation rates without excessive thermal stress. Available shield materials with the desired neutron moderating and absorbing characteristics are extremely expensive or do not have the necessary structural properties.

The solution:

A composite material combining structural and thermal properties of aluminum, neutron moderating properties of titanium hydride, and neutron absorbing characteristics of boron carbide.

How it's done:

Aluminum is an excellent structural material with good strength and ductility, even at cryogenic temperatures, and high thermal conductivity. Titanium hydride (TiH_2) has excellent neutron moderating capability. boron carbide (B_4C) is a good neutron absorber, producing alpha particles and 1/2 Mev gammas rather than the more troublesome high-energy secondary gammas.

To obtain the composite material, the aluminum, TiH_2, and B_4C are mixed in powder form and extruded into the required shape with a commercially available high-energy extrusion machine operating at room temperature.

Test samples containing up to 30 v/o TiH_2 and B_4C show tensile yield-strength (0.2% set) of up to 28,000 psi, ultimate tensile strength of up to 30,000 psi, and elongations at rupture of up to 8 percent, depending on the specific mixture being tested. Microphotographs of longitudinal sections of such samples show a sound aluminum matrix with a uniform dispersion of TiH_2 and B_4C particles.

Calculations indicate that the composite material has shielding efficiency superior to most of the other solid shielding materials tested, combining desirable properties of each constitutent to make a new class of materials that is extremely promising for nuclear shielding applications.

Note:

Inquiries concerning this innovation may be directed to:

AEC–NASA Space Nuclear Propulsion Office
U.S. Atomic Energy Commission
Washington, D.C. 20545
Reference: B67-10265

Patent status:

No patent action is contemplated by AEC or NASA.

Source: A. M. Poindexter
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