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8. CERAMICS 287

8.1 Ceramic Processing Aided by Millimeter-Wave Testing (Los Alamos National Laboratory and Oak Ridge National Laboratory) 289

In a special fusion-neutron irradiation simulation, ^{17}O is being substituted for ^{18}O in 99.5% alumina for raising the potentially deleterious helium gas yield during fission-neutron irradiation up to levels closer to those expected from the fusion neutrons of a deuterium-tritium fusion reaction. For test specimens from two exploratory processing trials at ORNL, done without the expensive ^{17}O enrichment, millimeter-wave (MMW) dielectric data taken at LANL indicated decreases in loss tangent values and in scatter in the dielectric constant values when concentrations of sample defects were apparently reduced. Complementary tensile strength values for enriched specimens correspondingly increased. These data are useful for evaluating potential rf-window performance, but also indicate that dielectric properties correlate with mechanical strength and serve as a sensitive and selective nondestructive measure of general material quality. In some cases, these data can also distinguish between absorption vs. scattering losses and provide estimates of pore sizes. Future dielectric data are planned on enriched alumina specimens — both control and neutron-irradiated.

9. BERYLLIUM 297

9.1 Microstructural Examination of Beryllium Irradiated at 400°C to 8 dpa (Pacific Northwest Laboratory) 299

9.2 Tritium Release from Irradiated Beryllium at Elevated Temperatures (Pacific Northwest Laboratory) 305

Sheet tensile specimens of commercial cast beryllium are found to be brittle following irradiation at 400°C to 8 dpa. Failure is by either transgranular brittle fracture or grain boundary embrittlement, depending on specimen thickness. Embrittlement is ascribed both to helium bubble formation at grain boundaries and to C-type loop formation. Loop formation of this type has not previously been reported in the literature.

Tritium release kinetics have been measured for neutron-irradiated beryllium in the temperature range of 573–884 K. Two tritium release tests of 270 and 550 h are the first in a series of tritium release tests on irradiated Be in support of the International Thermonuclear Experimental Reactor (ITER) blanket designs. Real-time tritium release curves were measured by an ionization chamber after temperature step changes of 100 K under tightly controlled conditions specific to ITER. The experimental conditions were designed to measure diffusion-controlled release of tritium from irradiated Be. The preliminary conclusion from this data set is that a unique rate-controlled mechanism is not distinguishable. Apparent diffusion kinetics at lower temperatures give way to a burst release at 884 K, coincident with a restructuring and bubble coalescence in this fully dense material.