PLUTONIUM **Implantation**

Creating experimental samples

As a nuclear weapon ages, plutonium decays into a uranium atom with the emission of a helium nucleus. The helium may coalesce to form bubbles that could weaken the material. To characterize helium bubble size and evolution, CAMS staff fabricate plutonium samples containing up to one-atomic percent helium via a process known as ion implantation. CAMS's high-energy ion beamline can implant helium ions in minute samples and mimic how helium builds up during the natural decay process. By sequentially lowering the helium ion energy, the depth of the implanted ion is successively reduced, producing a plutonium sample with relatively uniform helium content over the implanted depth. Diagnostic devices along the beamline and at the target chamber include thermal cameras and vacuum gauges. If the temperature inside rises too high or a vacuum failure is indicated, a valve at a bend in the beamline closes to stop the ion beam.

Analysis of implanted samples indicates that bubble size appears to be similar to that observed in 20- to 40-year-old plutonium, and the visible bubble density is similar to that found in 40-year-old plutonium. These results indicate that helium bubble evolution may be governed by the same processes regardless of whether helium is produced by decay or by implantation.

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