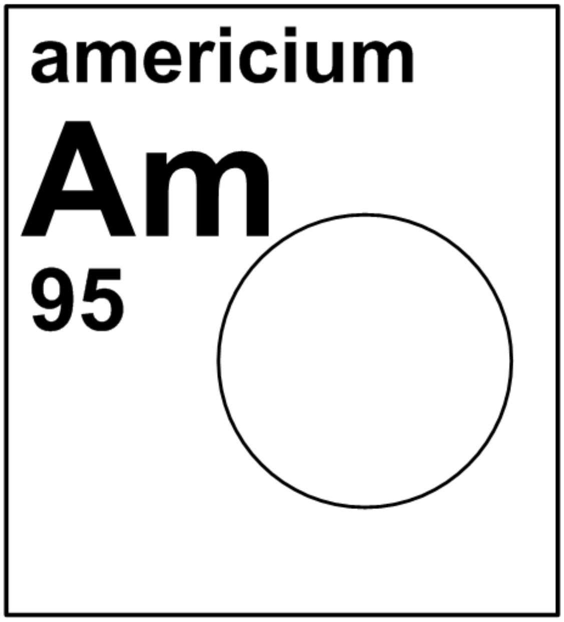
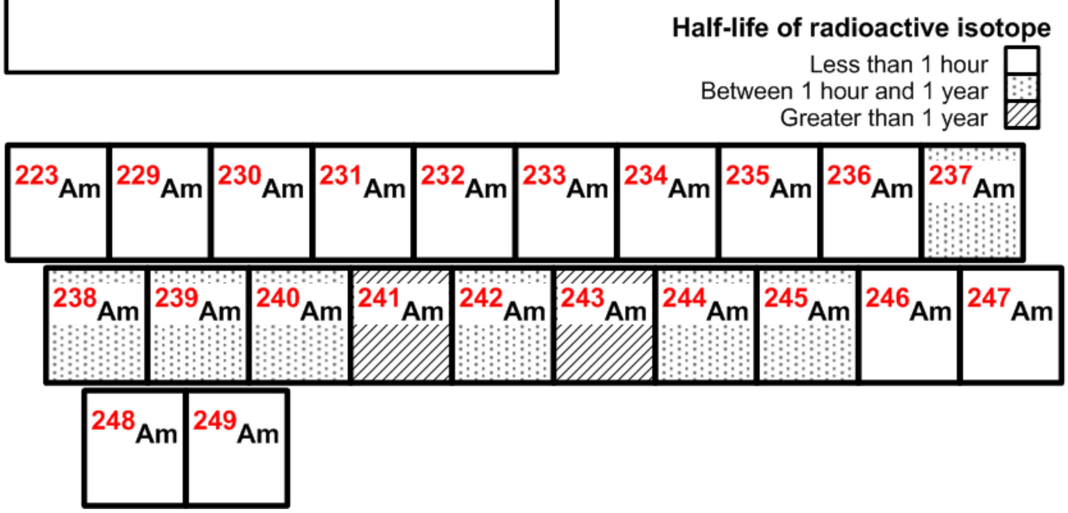
## 4.95 americium




| Stable isotope | Relative atomic mass | Mole fraction |
|---|---|---|
| (none) | | |




Americium does not occur naturally in the Earth's crust. In 1944, it was first synthesized by Glenn T. Seaborg and his team at the University of California Laboratory in Berkeley via multiple **neutron** capture reaction on $^{239}$Pu to produce $^{241}$Am.

### 4.95.1 Americium isotopes in industry

$^{241}$Am (with a **half-life** of 433 days) is used in smoke detectors as an ionization source to detect smoke (Figure 4.95.1). A small piece of $^{241}$Am oxide is housed inside **ionizing** smoke detectors. The americium compound emits **alpha particles** that strike air molecules in their path, causing them to ionize. The ions carry a current from one plate in the detector to a second plate. Current flows continuously until smoke disrupts the current between the two plates. The alarm sounds when the current is disrupted by smoke [72, 611, 612].

$^{241}Am$ is used for the control and measurement of industrial material thickness and product quality. In manufacturing, for example, a small piece of $^{241}Am$ is placed above a conveyer belt and a **Geiger counter** (used to count alpha particles) is placed below the conveyor belt. A specific quantity of radiation is expected to be measured by the Geiger counter. If the product being manufactured (i.e. glass) is thicker than expected, less radiation will be measured, and the product will be rejected [72]. The **gamma radiation** of $^{241}Am$ is also used in a variety of gauges. Thickness gauges, fluid-density gauges, aircraft fuel gauges, and distance-sensing devices use the density-measuring capabilities of the emitting **gamma rays** and radiation detector to function.

When $^{241}Am$ is mixed with beryllium ($^{241}AmBe$), it emits **neutrons** at a high rate. This high rate of neutron generation is useful in oil-well operations to monitor the rate of oil production, and it can also be used in well logging to log the porosity (fraction of void volume to total volume of a material) of the geologic units along the sides of a borehole. Gamma rays from $^{241}Am$ are also used as portable **X-ray** machines to determine where new wells should be drilled. When a small pellet of $^{241}Am$ is placed in a sealed titanium capsule, it can serve as a portable source for gamma **radiography**, which is more penetrating than X-rays, to test various materials for defects, such as invisible cracks or faulty welds in pipelines [72, 611, 613].

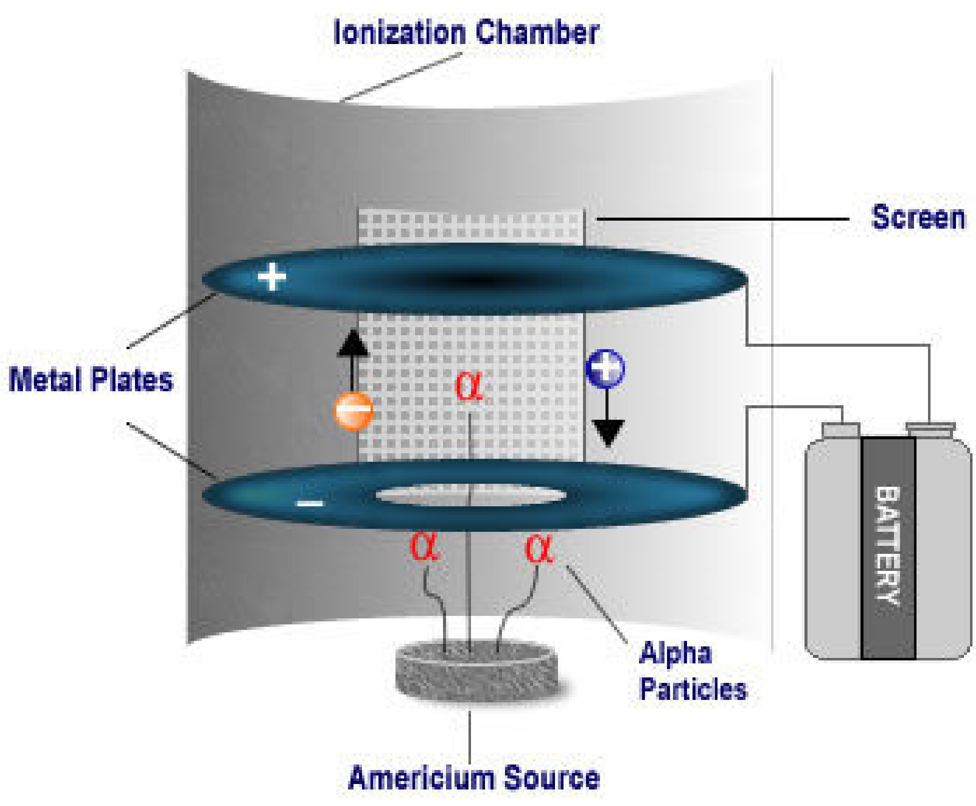



**Fig. 4.95.1:** In a smoke-free chamber, the ionized air molecules create a current between the two metal plates having a voltage difference. Current flows continuously until smoke disrupts the

current, at which time the alarm sounds. (Diagram Source: US Environmental Protection Agency) [612].

#### 4.95.2 Americium isotopes in medicine

Gamma-ray emissions from $^{241}Am$ were used as a radiation source for medical diagnostic tests. In particular, $^{241}Am$ has helped to provide accurate diagnoses of thyroid function, but this use of americium is now obsolete [614].