Gadolinium as a converter foil

What is it used for?

* Neutron moderation

One of the many ways neutrons can interact with matter is through neutron absorption. Neutron absorption occurs

Natural gadolinium consists of 6 stabel isotopes and one unstable isotope. The two isotopes which contribute the most to it’s neutron absorption cros-section are Gd-155 and Gd-157 with cross-section 60900 and 254000, respectively. This is quite a significant difference compared to the cross section og B and Li absorber. When a neutron beam traverses a volume of natural gadolinium and its isotopes undergo neutron capture it result in daughter isotopes, gamams, conversion electrons, characteristic X-rays and ACK electrons. The neutron capture reaction equation of Gd-155 and Gd-157 are

A close up of a logo

Description automatically generated

When an isotope absorbs an incoming neutron it enters an excited state. Deexitation of the isotope occurs in the for om either gamma or conversion electron emission, two competing processes. The Q-value (characteristic decay energy?) of the reaction determines the energy of the gamma ray, energy spectrum is continuos with Q-value being the limit. In other words, gammas emittet from Gd-155 and Gd-157 have energies 7.9MeV and 8.5 MeV, respectively, or less. The most common energies. Characteristic energy peaks? Competing with gamma is the emission of conversion electrons, which in contrast to gamma emission, has a descrete energy spectrum. Primary electron sfrom internal conversion vary a fixed part of the characteristic decay energy, thus resulting in a descrete energy spectrum.

Once a conversion electron

range maksimum being the Q-value and he energy of an emittet gamma ray is dependent on the Q-value of the reactions, it’s maximum being Q value

Emission of a gamma and an conversion electron are competing processes, either

Gadolinium

* Used as a neutron converter
* Has a high neutron absorption cross section
* Cost? Density?

Natural gadolinium

* 6 stable isotopes 1 unstable isotope
* Gd-155 and Gd-157 contribute to high neutron absorption cross-section.
* Reaction equation of the isotopes are : …
* Characteristic decay energies are 7.9 and 8.5 MeV, respectively
* Products of the reaction is a daughter fissile nuclei (a nuclei that has underwent fission with a thermal neutron), gamma rays, internal conversion (IC) electrons, X-rays and Auger and Coster-Kroning (ACK) electrons.
  + After capture the fissile nuclei is in an exicted state.
  + To deexcite it either emits high/low(?) energy gamma rays or internal conversion electrons, two competing processes.
    - Gamma
      * Continuous energy spectrum
      * Maksimum energy is the characteristic decay energy of the neutron capture reaction.
    - Conversion electrons
      * *A radioactive decay process (def.?)*
      * Possible when gamma-decay is possible, except when atom is fully ionized (why?)
      * The fissile nucleus interacts electromagnetically with one of the orbital electrons of the atom. As a result
        + An electron is ejected from the atom, known as the IC electron.

Not to be confused with B-decay, electron emission from the nuclei.

Atomic number unchanged, since electron emitted from shell and not nuclei.

* + - * + Electrons from a higher energy level descend and fill the hole left in place of the ejected (IC) electron.

Descending electrons emit characteristic X-rays, auger electrons, or both.

Filling of an inner shell vacancy can be accompanied by an electron from the same atom, these are called Auger electrons. Coster-Kroning electrons are a special case of the auger process in which a vacancy is filled by an electron from a higher subshell of the same shell.

The secondary electrons, those produced by IC electrons, are refered to, in this thesis, as Auger and Coster-Kroning (ACK) electrons.

* + - * IC electrons have a descrete energy spectrum. Characteristic energies of
        + Gd-155: 0.089 MeV and 0.199MeV
        + Gd-157: 0.079 MeV and 0.182 MeV

Anything else?

* Reaction products are gammas and conversion electrons, competing processes.

The capture of thermal neutrons by gadolinium produces electrons with characteristic energies, which depend on the type of gadolinium isotope. The isotopes with the greatest neutron absorption cross-section are Gd-155 and Gd-157, 60900 and 254000 barns, respectively. The electron energy is dependent on the isotope of gadolinium. In natural gadolinium the mo