Reactor Produced Radioisotopes used in Nuclear Medicine

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The course of nuclear reactions is typically written as if a small component "a" delivers mass and/or energy to a larger nucleus "A", forming a product nucleus "B" and a small component "b": a + A = B + b. The short notation is A(a,b)B. The nucleus A is called the "target", the small component a is the "projectile". Whenever the projectile constitutes a nucleon (n or p) or a cluster of nucleons such as the nucleus of deuterium (d), He (the α-particle) or larger nuclei, and as far as the kinetic energy of these projectiles is below a limit which splits the target nucleus into many pieces (a type of nuclear reaction called "spallation"), nucleons are "transferred" in the course of the reaction to or from the target nucleus. This type follows a "nucleon transfer mechanism". It will be discussed in detail for *neutron capture reactions*. In addition, there is a second process relevant to radioisotope production, namely *neutron-induced fission*.

This presentation thus focuses on the specific features of those two processes. It first introduces the features of the two types of the neutron induced nuclear reaction processes, i.e. neutron capture and induced fission. It discusses the first process in terms of thermal neutrons, their flux and nuclear reaction cross section for (n,γ)-processes and the second process for ^{235}U fission (n,f). Second, it discusses the individual production pathways of the clinically most relevant nuclear reaction products obtained at nuclear reactors: ^{89}Sr, ^{90}Y, ^{99}Mo, ^{131}I, ^{153}Sm, ^{177}Lu, ^{186}Re, ^{188}Re for (n,γ)-processes and ^{90}Sr, ^{99}Mo for uranium fission (n,f).

References:

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