Hypothesis on the formation of copper in a nickel-hydrogen reactor

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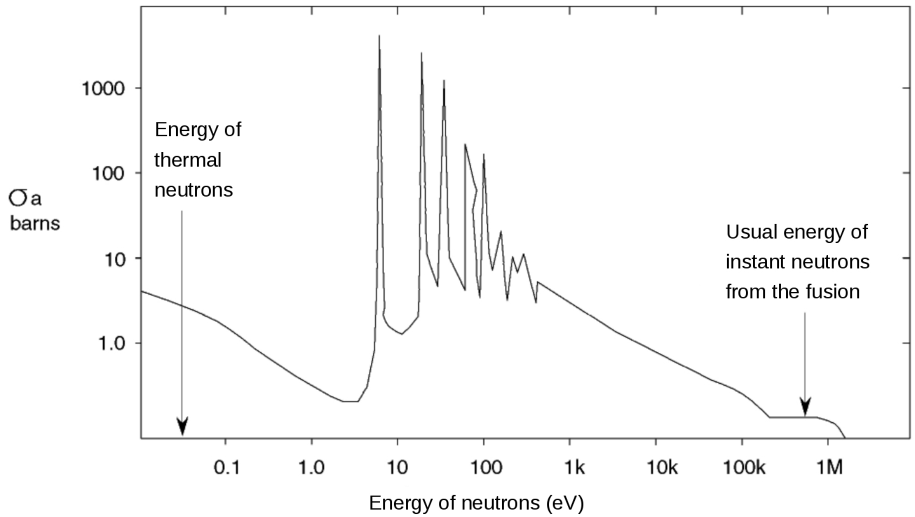
Content of this document :

it is only the matter but reflections based on the knowledge bases in nuclear physics. Nothing in this document is intended to be a fact, proof or any certainty. So for now, all that follows in this document is only a hypothesis…. Obviously, except as regards the principles of nuclear physics known and demonstrated.

The "cold fusion" nickel and hydrogen (H gaseous or watery)

The residue observed in these types of reactors being Cu ashes or a copper forming on a nickel cathode, there must be absorption of a proton in the nuclei of nickel; although this is highly unlikely due to the positive charge of the nucleus and the proton. By cons, there might be a possibility of this happening by a phenomenon already known for neutrons, called "resonance absorption". Herebelow is a typical example for neutrons.

The term, "absorption cross section" of a nucleus, is the probability that a nucleus absorbs a neutron. The probability unit is the barn. We know that the absorption cross section of a core decreases as a function of neutron energy. Example for uranium 238 : if a curve is plotted of absorption cross-section versus a function of neutron energy between 5 eV and 1 keV, there are absorption peaks, including a peak in a particular precise energy level of 8 eV. For this energy value, the absorption cross section reaches 6000 barn, although under 10 barn on each side of the peak. This is an absorption peak of neutron resonance.



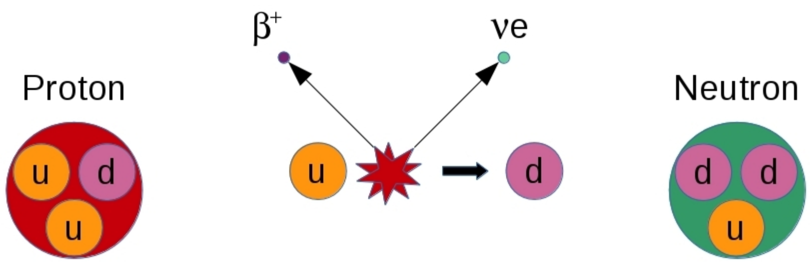
Variation of the absorption cross section of uranium 238 in function of the neutron energy

So, IF a Nickel core absorbs a proton WHICH DOES NOT HAVE the required energy, it may be a phenomenon similar to resonance but applied to the proton. The main question remains : *Is such a phenomenon possible with a proton ?* Probably not...? However, the transmutation of nickel to copper in a "Nickel and Hydrogen" reactor has been observed ! Here is another more likely explanation I considered ...

The hypothesis of protons "Intrusers"

A proton penetrates into the crystal structure (cubic face-centered) of Nickel. Let's call this Proton "an INTRUDING proton". This OMIT INTRUDING proton is then surrounded by 14 nickel atoms comprising each 28 protons, i.e a total of 392 protons. For the 14 Nickel cores, with their 30 (32 or 36) neutrons ensuring their stability, the INTRUDING proton does not destabilize them. BUT we can assume that the proton intruser becomes very unstable, emits a beta particle or capture an electron, THUS BECOMING an intrusive neutron.

Scheme of proton decay



$$ {}^{1}_{+1}p \rightarrow {}^{0}_{1}n + {}^{0}_{+1}\beta + {}^{0}_{0}\nu_e $$

Once in thermal equilibrium with its environment or having an energy level allowing resonance absorption, the neutron intruder is much more likely to be absorbed by a nickel core, compared when still a proton ! Obviously a neutron surplus to a nickel core made thereof an isotope of Nickel and not a copper atom. A new question then arises :

Which nickel isotope is most likely to become copper after absorption of a neutron?

Let's first observe the most abundant isotopes in the nature, knowing that the most stable isotopes are most abundant.

^{58}Ni at 67.76 % ^{60}Ni at 26.16 % ^{64}Ni at 1,16 %

Situation 1 : ^{58}Ni

If ^{58}Ni element absorbs a neutron, one obtains ^{59}Ni, but this element is relatively stable with a half- life of 80,000 years and decays in ^{59}Co by electron capture. So Copper can not come from ^{59}Ni.

Situation 2 : ^{60}Ni

If ^{60}Ni element absorbs a neutron, one obtains ^{61}Ni, but ^{61}Ni can not produce ^{61}Cu, since ^{61}Cu disintegrates in ^{61}Ni by beta^{+} emission. Also, as the half-life of ^{61}Cu is only 3.3 hours, after 33 hours it would remain only 1/1024th (1/2 exponent 10) of ^{61}Cu product. This does not seem to be the case with the copper produced in a reactor Ni-H.

Situation 3 : ^{64}Ni

If ^{64}Ni absorbs a neutron, one obtains ^{65}Ni. The latter is very unstable and inexistent in the natural state. Too rich in neutrons, this element will issue a β^- radiation, which means that a neutron has turned into proton. The ^{65}Ni would be transmuted into ^{65}Cu that it, is a stable isotope; since it is present at 30.9% in nature. Therefore, Cu product and which woul persist in the transmutation Ni -> Cu, would come from ^{64}Ni.

We would have the following sequence of disintegration :

1. the proton intruder (p_i) decays into a neutron intruder (n_i), by issueing β^+ emission or by electron capture. It is possible that the proton captures an electron belonging to nickel atoms.

$$p_i \rightarrow n_i + \beta^+ + \nu e^1 \quad \text{or} \quad p_i + CE \rightarrow n_i$$

2. the proton intruder is absorbed by a ^{64}Ni core which becomes the ^{65}Ni. The latter disintegrates into 65Cu through emission beta -.

$$n_i + {}^{64}Ni \rightarrow {}^{65}Ni + \gamma \quad \text{and} \quad {}^{65}Ni \rightarrow {}^{65}Cu + \beta^- + \gamma$$

The neutron intruder could be absorbed by any isotope of nickel. Hence the idea of using nickel which would be enriched in ^{64}Ni.

The 5 possible neutronic interactions

To understand the following, I thought it appropriate to remind you neutronic interactions (possible interaction of a neutron on an atomic nucleus).

Here are the four other neutronic interactions that do not involve conversion of mass into energy, at least not as a production of energy from the strong nuclear force (unlike the fusion or nuclear fission).

- The elastic scattering (n, n)
- The inelastic scattering (n, n_γ)
- The transmutations (n, p) and (n, α)
- The radiative capture
- The nuclear fission

Note that **nuclear fission** is the only **neutronic interaction** implying a conversion of mass into energy, according to the formula $E = mc^2$, involving the strong nuclear force.

By cons, **nuclear fusion**, which also involves a conversion of mass into energy by involving the strong nuclear force, is not **a neutronic interaction**.

The 4 neutronic interactions in question

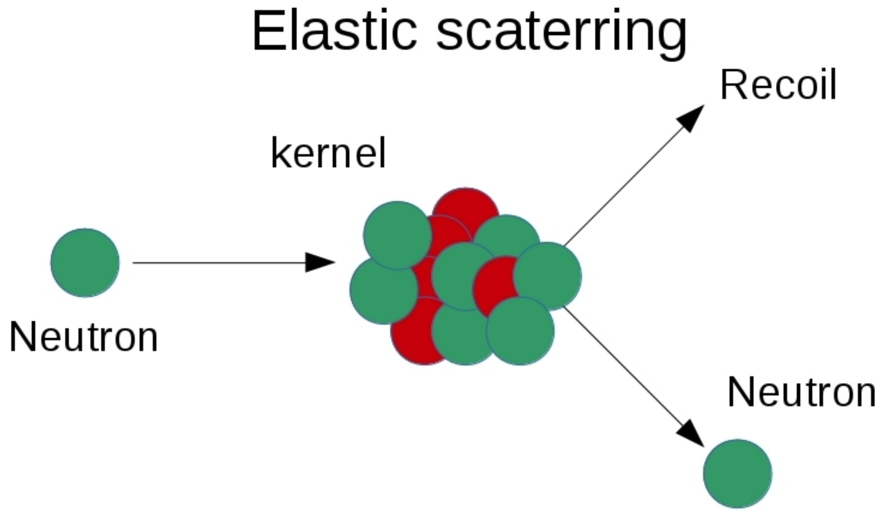
(Course Preview: Fundamental Principles of CANDU reactors)

As one is not concerned by the fission, let's focus on the first four interactions.

1. The elastic scattering (n, n)

   Elastic scattering recalls the collision between billiard balls. A neutron strikes a nucleus, it transfers the energy and bounces in a different direction (sometimes the nucleus absorbs the neutron and then retransmits it with the same kinetic energy).

   The fraction of the initial energy which will be retained by the kernel depends on the angle of incidence - in full "front" or at an angle - just like a ball hit by the cue ball on a pool table. The target nucleus absorbs the energy lost by the neutron and then moves at a higher speed.



2. The inelastic scattering (n, n_γ)

During a collision with a nucleus, a neutron can be absorbed temporarily. This recomposed core will be in an excited state. It will be de-energized by issuing a new less energetic neutron and a gamma photon that will carry the energy difference. This interaction is the ***inelastic scattering***. It usually only happens during the interaction between a very fast neutron and a heavy nucleus, and it does not play a crucial role in the operation of nuclear reactors.

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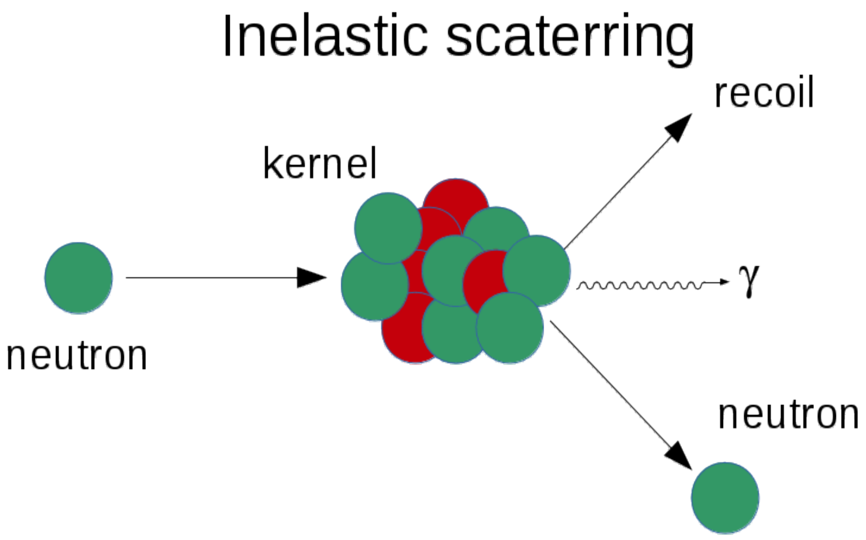


3. The transmutations - (n, p) and (n, α)

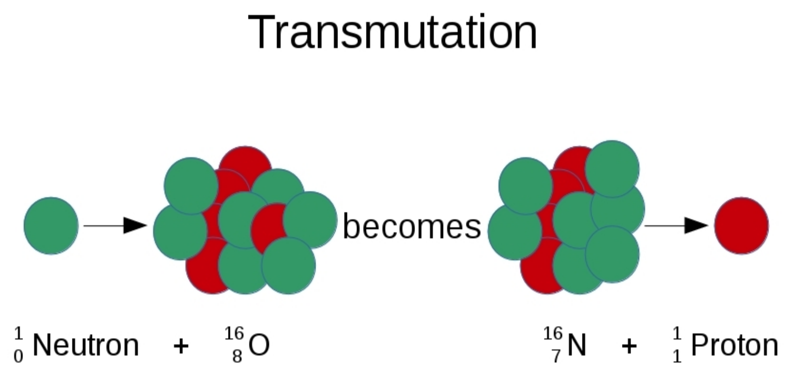
A core can absorb a neutron to form a reconstituted nucleus, which will be de-energized by emitting a charged particle: a proton or an alpha particle. A different core is formed by this reaction called transmutation.

The transmutation is the transformation of one element into another by a nuclear reaction.

Examples

1- Neutron proton reaction (n, p)

Oxygen 16 captures a neutron and emits a proton to form nitrogen 16



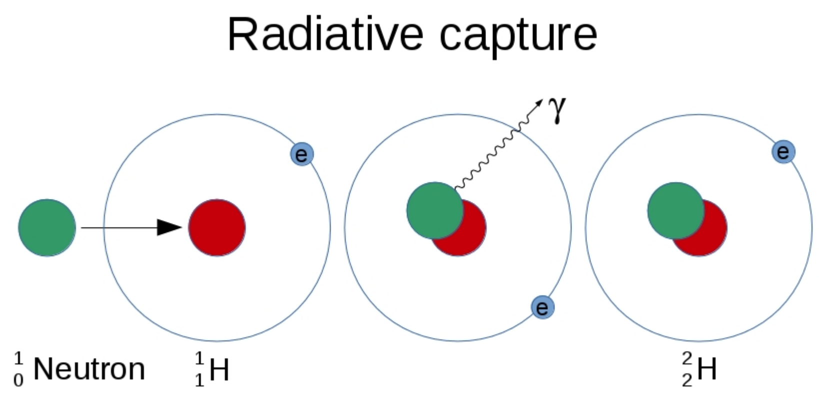
The product, nitrogen 16, is radioactive and its period is 7.1 seconds. This is an example of activation reaction. Nitrogen 16 emits beta particles and especially very penetrating gamma rays.

4. The radiative capture – (n, γ)

This is the most common nuclear reaction. The compound nucleus formed emits a gamma photon. In other words, the product nucleus is an isotope of the target nucleus. Its mass number increases by 1.

Exemples :

The simplest radiative capture is the absorption of a neutron by a hydrogen nucleus to form deuterium (or heavy hydrogen).



The deuterium formed is a stable core. However, several nuclei produced by the radiative capture are radioactive and emit betas and gammas.

The radiative capture of a neutron by deuterium produces tritium.

As can be seen, in the neutron interactions, only the radiative capture can produce an isotope which mass number increases by 1.

So, no matter what isotope of nickel absorbs a neutron, one has then a phenomenon of activation by radiative capture, followed by disintegration. And also, the energy released in a Ni-H reactor does not come from the strong nuclear force, but of the weak nuclear force or "electroweak".

The energy then would come from :

- The photon emission during the radiative captures,
- Emission of particles beta+, beta - and photons that accompany the disintegration not only of ^{65}Ni, but also any other isotope of nickel which after radiative capture, are unstable and disintegrate.
- And finally, all products of the disintegration of affiliations from unstable isotopes of nickel ... or any other isotope present in the nickel …

Therefore, according to my hypothesis, copper product in a reactor Ni-H could be produced by radiative capture of a neutron by the ^{64}Ni. After becoming ^{65}Ni and unstable, it disintegrates in 65Cu by $beta^-$ emission, a stable isotope of copper.

If my hypothesis is verified, as regards the production of ^{65}Cu in the reactor Ni-H, one can not say that it is cold fusion, because the absorption of a neutron is not a phenomenon pertaining to nuclear fusion.

That is why I think the extra energy that could be generated in this type of reactor is limited, because it is only generated by the weak nuclear force, via the disintegration of the electroweak force.

Technology contemplated

To incorporate the hydrogen or deuterium into any metal, the use of an ion implanter would provide the possibility of a precise control of the process, and appropriate measures to the search action.

In this way, one could precharge deuterium into a palladium electrode, measuring the amount of implanted ions per cm^2 and / or cm^3, control the implantation depth, the number of implanted ions, the temperature variation at the implantation to check an abnormal temperature increase on the sample ….

In short, a host of relevant data could be recorded that would focus research on the best combination of metal-ion-implantation energy, a.s.o …

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