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Title

Cold Fusion. Andrea Rossi's Method

Abstract

The interest on Andrea Rossi's Nickel-Hydrogen Cold Fusion technology is accelerating. In the present article I would like to answer a question posed by L. Kowalsky in Vixra: how can 30% of nickel in Rossi's reactor be transmuted into copper? "Everything should be made as simple as possible, but not simpler", says a guy. I apologizes if I am too simplistic here.

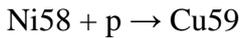
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Introduction

The interest on Andrea Rossi's Nickel-Hydrogen Cold Fusion technology is accelerating [1]. However, Rossi says that about 30% of nickel was turned into copper, after 6 months of uninterrupted operation. Kowalski [2]. says that “this seems to be impossible because the produced copper isotopes rapidly decay into Ni”. But how it works?

How it works

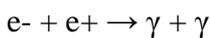
Following Focardi Rossi [3]. a Ni58 nucleus produces a Copper nucleus according to the reaction



Copper nucleus Cu59 decays with positron (e^+) and neutrino (ν) emission in Ni59 nucleus according to

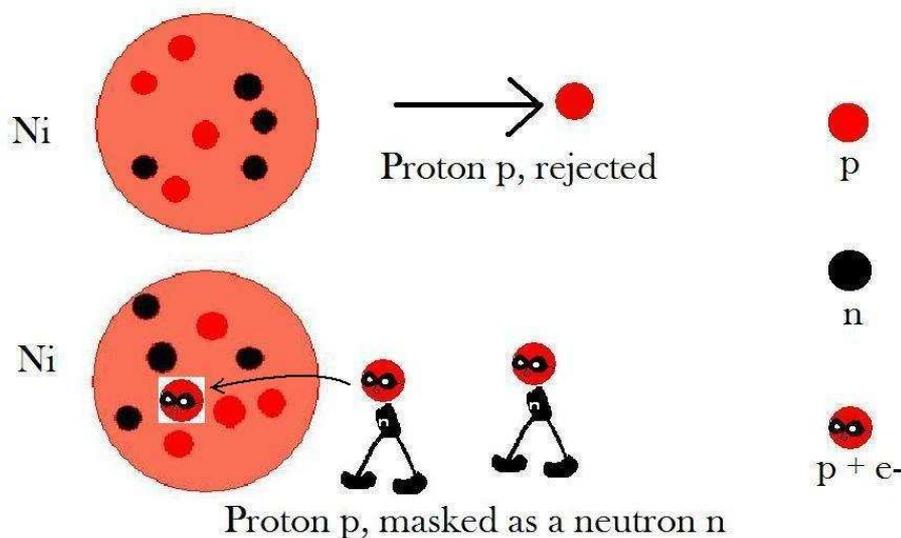


Then (e^+) annihilates with (e^-) in two gamma-rays

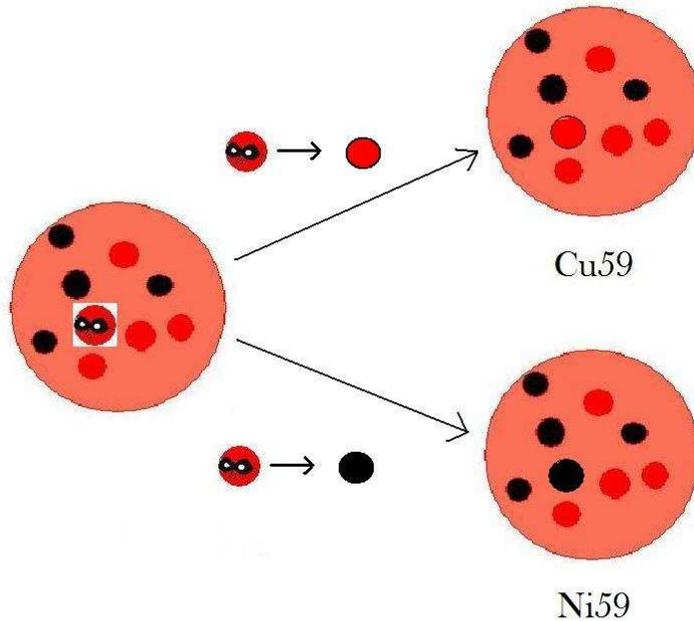


Starting [3] from Ni58 which is the more abundant isotope, we can obtain as described in the two above processes Copper formation and its successive decay in Nickel, producing Ni59, Ni60, Ni61 and Ni62. Because Cu63, which can be formed starting by Ni62, is stable and does not decay in Ni63, the chain stops at Ni62 (i.e. Cu63). Each process means some MeV.

Of course how can a proton p gets captured by the Ni58 nucleus? (and subsequent Ni59, Ni60, Ni61 and Ni62). Following Stremmenos [4]. a neutron-like particle, an electron proton pair, a mini-atom, a proton masked as a neutron, gets captured by the Ni58.



If the masked proton becomes a neutron the result is Ni59.
 In order to have Cu59 (increase of atomic number from 28 to 29) the electron (of the masked proton) gets ejected from the nucleus. The masked proton becomes a proton.



The same process holds for all the subsequent transformations, until Cu63.
 It remains to be understood the issue of the gamma radiation in the MeV range.

Numbers

I am an electronic engineer, so I need easy numbers in order to understand.
 However "Everything should be made as simple as possible, but not simpler", says a guy. Maybe I am too simple here.
 Let's calculate.

MeV for each Ni transformation

I read that starting from **Ni58** we can obtain Copper formation and its successive decay in Nickel, producing **Ni59**, **Ni60**, and **Ni62**. The chain stops at **Cu63** stable.
 For simplicity I assume all the Nickel in the reactor in the form **Ni58**.
 For simplicity I suppose for each **Ni58** the whole sequence of events from **Ni58** to **Cu63** and as a rough estimate I calculate the mass defect between (**Ni58** plus 5 nucleons) and the final state **Cu63**.
Ni58 mass is calculated to be 57.95380 ± 15 amu
 The actual mass of a copper-**Cu63** nucleus is 62.91367 amu
 Mass of **Ni58** plus 5 nucleons is $57.95380 + 5 = 62.95380$ amu
 Mass defect is $62.95380 - 62.91367 = 0.04013$ amu
 1 amu = 931 MeV is used as a standard conversion
 $0.04013 \times 931 \text{ MeV} = 37.36 \text{ MeV}$
 So each transformation of **Ni58** into **Cu63** releases 37.36 MeV of nuclear energy.

Nickel consumption

According to many blogs in the Internet “One hundred grams of nickel powder can power a 10 kW unit for a minimum of six months”.

How much of **Ni58** should be transformed, in six months of continuous operation, in order to generate 10 kW?

I follow a procedure outlined in [2].

10 kW is thermal or electrical (?) power. The nuclear power must be larger. Assume a nuclear power twice:

$20 \text{ kW} = 20,000 \text{ J/s} = 1.25 \times 10^{17} \text{ MeV/s}$.

Each transformation of **Ni58** into **Cu63** releases 37.36 MeV of nuclear energy.

The number of **Ni58** transformations should thus be equal to $(1.25 \times 10^{17})/37.36 = 3.346 \times 10^{15}$ per second.

Multiplying by the number of seconds in six months (1.55×10^7) the total number of transformed **Ni58** nuclei is 5.186×10^{22} .

This means 5 grams.

The order of magnitude is not exactly the same but seems to be plausible. This means also 5 grams of Nickel in Rossi's reactor transmuted into (stable) Copper after six months of continuous operation at the rate of 10 kW.

Remarks

Once finished the paper I've found that I used old Internet data for masses.

More recent data seem to be (see for ex. Wiki, isotopes of Nickel, isotopes of Copper):

Ni58(57.9353429)

Cu63(62.9295975)

With these data, mass of Ni58 plus 5 nucleons is $57.9353429 + 5 = 62.9353429$ amu

Mass defect 0.0057454 amu

This is 7 lower with respect to 0.04013 amu reported in the paper.

It means 7 times more Nickel, 7 times more Copper, $5 \times 7 = 35$ grams.

Conclusions

Rossi says that about 30% of nickel was turned into copper, after 6 months of uninterrupted operation. At first glance this seems to agree with calculations based on simple assumptions.

References

[1] Link, [Cold Fusion "Andrea Rossi" Method](#)

[2] L. Kowalski, “Rossi's Reactors Reality or Fiction?”, <http://vixra.org/abs/1103.0080>, March 2011

[3] A.Rossi, S. Focardi, <http://www.journal-of-nuclear-physics.com>

[4] E. Stremmenos, “Hydrogen/Nickel cold fusion probable mechanism”, www.journal-of-nuclear-physics.com/?p=338&cpage, March 2011