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# Hydrogen Transmutation of Nickel in Glow Discharge

**Vladimir K. Nevolin**

*National Research University of Electronic Technology (MIET), Moscow, Russia.*

**Abstract**

Background: The possibility of the existence of subatomic hydrogen states was theoretically predicted previously. Objectives: Prove that the transmutation of elements is possible in specially prepared conditions for hydrogen. Methodology: By comparing the mass spectra of deposits on silicon substrates and target electrodes, it is shown that a change in the composition is observed in a magnetron Argon. Results: An increase in the concentration of the nickel isotope ${}^{62}_{28}Ni$ and a decrease in the isotope concentration ${}^{60}_{28}Ni$ are shown. Conclusion: These results confirm the results obtained earlier in the heat generator Rossi, who worked more than a year, found an increase in the isotope ${}^{62}_{28}Ni$ due to a decrease in the proportion of other isotopes.

**Keywords**: transmutation, isotopes of nickel, glow discharge, argon, hydrogen

## INTRODUCION

It is considered that the cold transmutation of elements (cold nuclear reactions) has been experimentally demonstrated [1]. On the basis of this phenomenon, energy generators are created in which long-term release of thermal energy in excess of expended energy is observed [2]. From many experimental studies it can be seen that hydrogen, which plays a pivotal role in the reaction zone, may be delivered through a variety of chemical compounds; for example, using lithium aluminium hydride $LiAlH_4$. An analysis of the products of nuclear reactions suggests the possibility of many simultaneous nuclear fusion and decomposition reactions [3]. However, up until now, the uniquely fundamental question of overcoming the Coulomb barriers of the nuclei for all possible variants of the cold transmutation of elements entering into the reaction has not been solved.

In our opinion, the initiators of such reactions may in some specific cases consist of hydrogen atoms (deuterium) in previously unknown subatomic states predicted in [4,5], based on the application of the fundamental ideas of Louis de Broglie on the relationship of the particle's mass with the natural frequency of its oscillation [6]. In subatomic states, the proton is located in the electronic "coat" having smaller dimensional characteristics, comprising 0.75 *a,* where *a* is the Bohr radius; this contributes to lower subatomic polarisability. Electron density distribution in a hydrogen nucleus is radially compressed due to the Coulomb field of the proton compared to the electron density distribution of probability for a free electron. The angular probability density distribution associated with the motion of the electron spin remains the same as in the free electron. This distribution is significantly different from an isotropic distribution of the probability density in the hydrogen atom in its ground state, which is the root cause of the high dielectric strength of the subatoms. In view of this fact, it is possible that the electron breakdown only occurs in superstrong static Coulomb fields with an energy greater than the self-energy of the electron $m_0c^2$ when it becomes a noticeable effect of the nuclear force field. Nevertheless, the ionisation energy of the subatoms is only 4/9 of the ionisation energy of the hydrogen atom, which corresponds to $\varepsilon_{is} = 6.02$ eV.

## OBJECTIVE

Accordingly, for the appearance of hydrogen subatoms [4,5], hydrogen ions are necessary in the near-surface layers of the metal; for example, in nickel with a zero translational energy and significant quantity of electrons with the energy $\varepsilon_{is}$. In this case, it is desirable that the sum of the electronic work function from the metal and the Fermi energy of electrons is less than the ionisation potential of hydrogen.

Studies of metal cathode glow discharges in an atmosphere of hydrogen (deuterium) are the most appropriate means for the realisation of such a situation. Notable results of cold transmutation of elements were obtained using this method in [7] with a palladium cathode.

## METHODOLOGY

To obtain experimental evidence for the existence of cold transmutation of elements based on the proposed model, the British-made Emitech K575X sputter coater was selected. The target was prepared from nickel, with a polished silicon wafer (Si KDB-7.5 (100)) used in microelectronic technology used as a substrate. The actuation gas was argon. Nickel target with a thickness of 300 microns was selected as the metal most used in thermal energy generators [2]. The aim of the experiment consists in a comparison of the elemental composition of the substrate and the target application of nickel in argon discharge with that obtained in a discharge of argon and hydrogen. The concentration of hydrogen in the mixture was no more than 10%. In the installation, an instantaneous flow gas pressure control mode is realised in the discharge chamber. The magnetron worked with periodic inclusion.

In the case of nickel deposition on a silicon substrate (with a chromium sublayer for better adhesion of the nickel), the glow discharge in argon was carried out four minutes and an average of fifteen minutes of discharge cutoff for cooling the target and the discharge chamber. Ten cycles of the nickel coating film were performed. The average discharge rates were ~ 118 mA; vacuum conditions during the coating of films averaged ~ 1.1 Pa.

In the case of discharges in the argon / hydrogen mixture, the situation had somewhat changed. A more significant heating of the discharge chamber was observed. The pause between discharges was increased to an average of twenty minutes; vacuum during discharge averaged 0.83 Pa. The discharge current was 140 mA; the plasma frequently ignited after application of voltage after about 30 seconds. The change in the heat emission could be explained by the emergence of thermochemical reactions – formation of nickel hydrides. However, these compounds are unstable, especially at high temperatures of the nickel target. Only traces of them are found in the mass spectra. The change in the heat discharge can also be attributed to changes in the elemental composition of nickel films due to nuclear reactions.

Indeed, the ionisation potential of hydrogen is less than the ionisation potential of argon, so the discharge plasma of hydrogen may be found predominantly in the ionised state. Hydrogen ions slowing down in the titanium target will recombine at a certain depth. Valence electrons are transferred to hydrogen ions in the usual state. To counter this process is the radiation of the heated metal target and glow discharge plasma with photon energy including exceeding the ionisation potential of hydrogen. In this connection, part of the hydrogen can be ionised in the stationary state. This portion of the hydrogen ions may have the possibility to move into the sub-atomic state by the valence electrons of the metal with the energy of $\varepsilon_{is} = 6.02$ eV. The study of the photons from these processes will excite the electronic subsystem of the metal target. Thus, for the emergence of hydrogen subatoms, there should be a target threshold temperature below which the occurrence of hydrogen subatoms is unlikely. It is clear that this temperature cannot be above the plastic flow temperature of nickel. In the case of a glow discharge parameter that determines the target temperature, the discharge current manifests itself at a given voltage.

Subatomic hydrogen states exist for a short time – from birth to the time of delivery of subatoms in the area of nuclear forces. By comparing the mass spectra of deposits on silicon substrates, as well as the mass spectra of the target from the front and reverse sides, it is possible to establish the presence of changes in the element composition.

Mass spectrometric measurements were carried out using two different instruments – TOF-SIMS and IMS-4f – of the two organisations. The main problem encountered in the analysis of the isotopic composition was the presence of an uncontrolled "chamber" of impurities on the walls of the magnetron and other items carried in the discharge plasma onto the substrate and target. Isotopes of sodium, aluminium and potassium were also found on local regions of the target surface. In connection with this, the scope of study of the spectrum of isotopes of nickel relative to the target was narrowed.

## RESULTS

To explain the change in the isotopic composition, we will write down the potential reactions. The formation of hydrogen subatoms occurs by reaction:

$$ {}_1^1H + e \leftrightarrow {}_1^1H^* \pm \Delta\varepsilon \tag{1}$$

Here ${}_1^1H^*$ - hydrogen subatoms $\Delta\varepsilon = 6.0eV$ - energy radiation (absorption) of ultraviolet rays associated with the transition to the subatomic state or collapse thereof. In the nuclear field of the target, the subatom can decay into an electron and a proton, and nuclear reactions are possible along two channels: capture of electron by a nucleus of the target; tunnelling and capture of the proton by the target nucleus, as well as direct involvement of hydrogen subatoms as the neutral particles in nuclear reactions. Nuclear reactions with protons and electrons result in a change in elemental composition. Other sources of these particles than hydrogen subatoms are possible. In connection with this, we are henceforth interested in further changes in the isotopic composition of nickel, which may occur due to nuclear reactions with hydrogen subatoms.

Since there are no natural nickel metals and isotopes ${}_{28}^{59}Ni$ and ${}_{28}^{63}Ni$, we consider the variant of transmutation by chain of elements: ${}_{28}^{60}Ni$ through ${}_{28}^{61}Ni$ to ${}_{28}^{62}Ni$ with the aid of hydrogen subatoms using binary collisions:

$$ {}_{28}^{60}Ni + {}_1^1H^* \rightarrow {}_{28}^{61}Ni + {}_1^1H^* \rightarrow {}_{28}^{62}Ni + \Delta\varepsilon_1 + \Delta\varepsilon_2 \tag{2}$$

Here the energy due to the first reaction is: $\Delta\varepsilon_1 \sim 67.5keV$; by the second $\Delta\varepsilon_2 \sim 94keV$. The reactions (2) lead to an increase of the peak value ${}_{28}^{62}Ni$

compared with the peak ${}^{60}_{28}Ni$ in the film relative to the same ratio on the reverse side of the target. Indeed, the experiment confirms this fact:

$$({}^{60}_{28}Ni\,/\,{}^{62}_{28}Ni\,)_f/({}^{60}_{28}Ni\,/\,{}^{62}_{28}Ni\,)_t \sim 7.67/7.78$$

The effect at ~ 1.5% corresponds to the small proportion of hydrogen in the gas mixture (~10%) and the small proportion of hydrogen actually participating in the reactions. The energy output of these reactions does not exceed 100 *keV*, which is consistent with the estimates of [3].

## CONCLUSION

In the Rossi thermal generator, which was working for over a year, an increase in isotope ${}^{62}_{28}Ni$ was found by reducing the proportion of other isotopes [2]. To adjudge a change in the element composition of other admixtures participating in the possible nuclear reactions is not possible in this experimental setting.

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