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GRAPHITE-LIKE STRUCTURES, SYNTHESIZED FROM GASEOUS He UNDER HIGH PRESSURE, BY BRAKING γ IRRADIATION OF MAXIMUM ENERGY OF 10 MeV — MODELING OF THE PROCESS*

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After irradiation of dense gas helium by braking gamma quanta with maximum energy of 10 MeV, in sufficiently long time, a graphite-like — large dimensions — structures were synthesized. Their chemical composition and main physical properties were definite. In order to explain the observed phenomena, a specific method of LENR — multinuclear reactions in dense helium — was used.

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1. Introduction

The aim of this article was a presentation of physical properties and crystallographic structure of carbon-rich, graphite-like (G-L) objects obtained by

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gamma irradiation of high pressure chamber (HPC) of volume about 1 cm^3, filled up with gaseous He. The helium in the chamber was compressed up to about 1.1 kbar before the irradiation. Observed irradiation effects — possibly effects of nuclear reactions — were partially described in [1–4]. HPC was irradiated by braking gamma quanta of maximum energy of 10 MeV during the time of 1.0×10^5 s in electron accelerator with electron current (1.2–1.4) 10^{14} e/s (about 20 mA). After irradiation, the pressure inside the chamber was dropped down to 430 bar, suggesting that about half of the gaseous helium was transformed to another than gaseous form. After the irradiation process, several macroscopic objects has been found inside HPC. The most spectacular were the black flakes of thickness about 0.22 mm — formed near the beryl bronze window for gamma rays. Many other smaller macroscopic objects have been also found.

First analysis using SEM and MPRA methods gave information that mentioned-above flakes consist mainly of carbon, oxygen and in smaller scale another elements up to iron (approximate content, in weight %, is as follows: 60% C, 30% O, 3% Mg, 2% N, 0.14% Si . . .). Two years after the first experiment, some physical properties of G-L object were estimated, as follows: low density (1.20 ± 0.20 g/cm^3, resistivity — higher than 10^{10} $\mu\Omega$m, high paramagnetic permeability and relative dielectric constant $\varepsilon_r = (3–4)$. Mechanical strength on compressibility was established to be about 10 MPa, with some difficulties due to natural cracks of objects. The first temperature investigations pointed out that temperature stability of flakes was no higher than 400°C (for graphite, it is defined by $T_{\mathrm{liq}} = 3000$°C). Graphite-like structure has been proposed: main surfaces with — as in graphite C location but with larger distance between those surfaces by 50%. In that larger space atoms such as oxygen, magnesium and other are located. The proposal is basing on obtained data using powder Siemens D500 diffractometer, supplied with semiconductor (Si) detector of high sensitivity. The second method used for chemical content determination (EDX) had, in principle, confirmed the first result [1]. Last investigations were done at the Faculty of Chemistry WUT, including infrared spectroscopy, and they confirmed the hypothesis that G-L objects are complicated, "weak crystalline" objects of strongly-deformed graphite-type with oxygen atoms in a separate layer (some kind of intercalate compound). Analyses of the Raman spectra gave information that observed red places on specimens surface (Fig. 2 (b)) are, simply, localization of many phosphorus atoms. A theory of generation of new nucleus during irradiation of pure helium under high pressure was proposed by Mishinsky [5] as a result of action of very strong magnetic forces in the case of high concentration of ortohelium particles (those result from irradiation procedure on parahelium), see Fig. 7 (a). Proposed by Wiśniewski analogical experiment with mixture of He and D_2 gases (in approximate content 50/50 at. %), during which no effects was observed, makes Mishinsky's hypothesis more probable. Taking under consideration results described above with He as well as with H_2, D_2 [4] and with Xe [6], we can speak about new — using low-energy nuclear reactions — macro-, micro- and nano-technologies. At the end of this introduction, one can make a comparison of G-L objects density with densities of the known carbon phases due to data shown in Fig. 1.

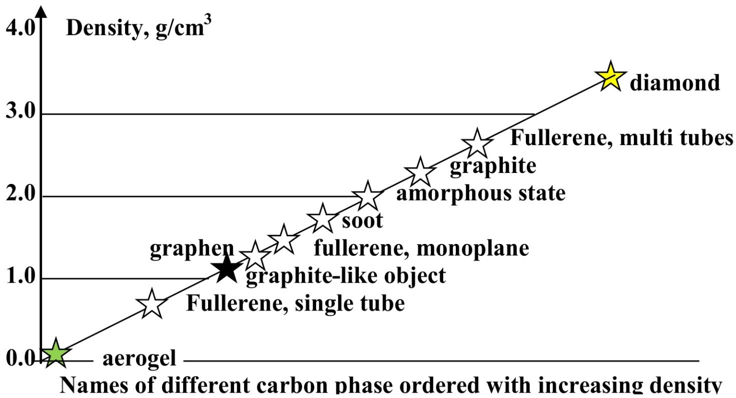

Fig. 1. Illustration of densities of known carbon phases and density of G-L object. Diamond localization on horizontal line has been arbitrary chosen.

2. Results obtained using Raman spectroscopy

Figure 2 (a) and (b) presents optical microscope images of the exemplary sample, with magnification 10 × (a) and 500 × (b) fragment; note small red areas at the bottom of photo (b). Both the surface and the internal structure of the sample had changed significantly after heating up to 400°C.

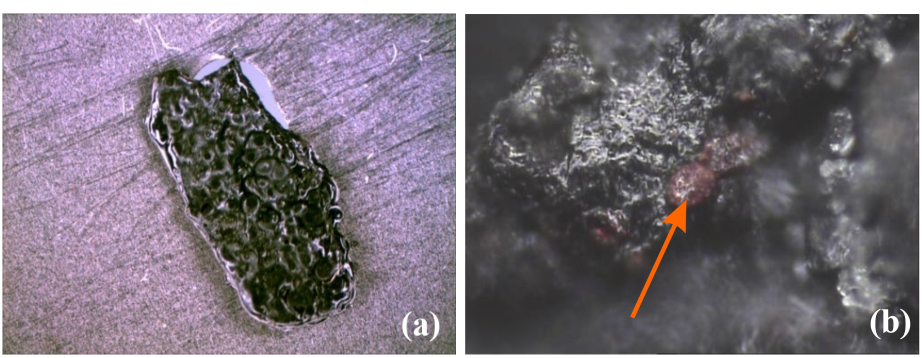

Fig. 2. (Color online) Strong changes of the specimen surface after heating it to temperature about 400°C (a), its fragment enlarged about 100 × and (b) enlarged about 500 ×. Note red areas (indicated by the gray/orange arrow).

The spectral pattern in the Raman spectra recorded in red spots is typical for red phosphorus. The presence of phosphorus in such red-colored areas was suggested earlier [3]. The Raman spectra recorded in the dark area of the samples possess spectral characteristic typical for carbon specimens. The position and relative intensities of the bands G (~ 1600 cm^{-1}) and D (~ 1320 cm^{-1}) points to the high level of the disorder [7]. The weak bands between 2870 and 2920 cm^{-1} and at ~ 1440 and 1300 cm^{-1}, characteristic for CH stretching and bending vibrations, give evidence of the presence of alkyl groups what can suggest appearance of a base for creating of more complicated carbon connections [1]. In our investigations, the Raman Nicolet Almega disperse spectrometer with a microscope and an automatic table were used.

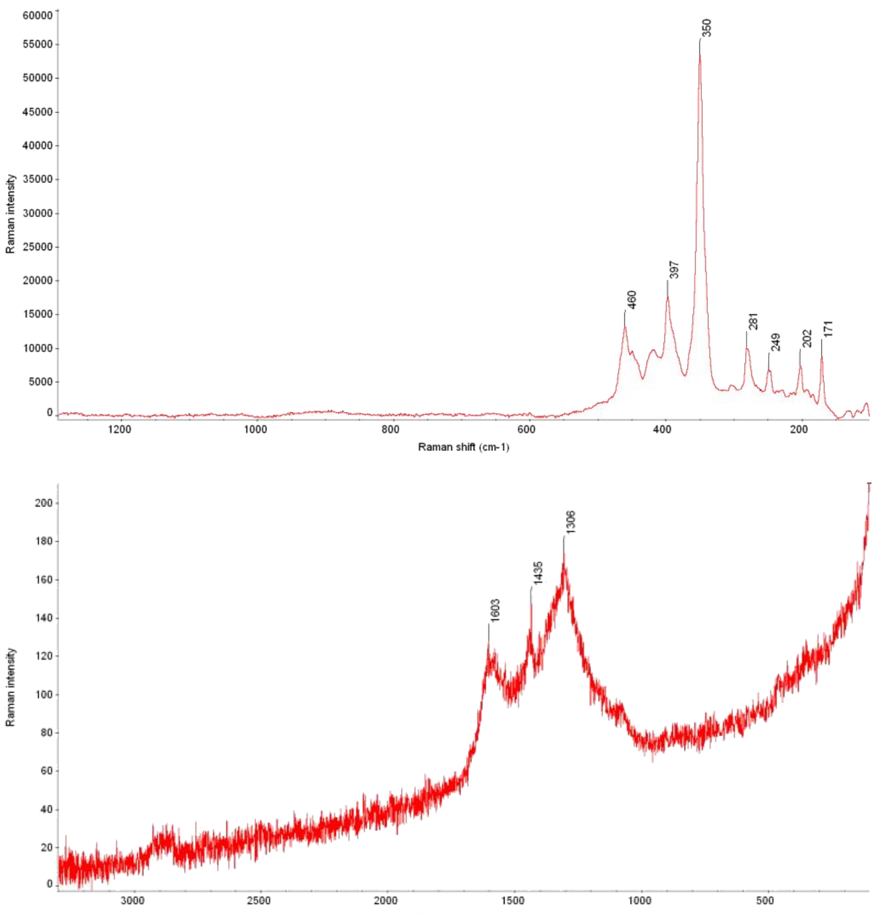

Fig. 3. Top: An exemplary Raman spectrum recorded in the red area shown in figure 2 (b). Bottom: The Raman spectrum of the graphite-like compound present in the dark area of the sample.

3. Investigations of the surface of G-L objects in polarized light classic microscopy

Very interesting view of object surface has been obtained using classical type microscopy in higher enlarged scale in normal and polarized lights. Photos, made at the Faculty of Chemistry WUT, see Fig. 4 [8], suggest highly complicated object structures. Here, no thermal treatment of objects was applied. If we take under consideration continuous space-time creation of new chemical elements (new atomic nuclei) during irradiation of dense He, in consequence, we should take under consideration strongly complicated solidification process of created objects.

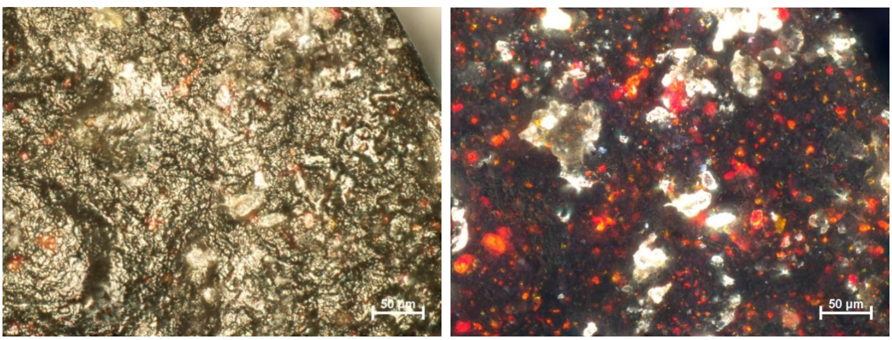

Fig. 4. Example of chosen graphite-like object photos. On the left in normal, on the right in polarized light.

In Fig. 5, there is shown an interesting object from graphite-like family. Its main chemical content is: C65O30Mn2.0 ..., dimensions: $7.3 \times 2.2 \times 0.22$ mm^3 (almost constant thickness), mass $m = 4.137$ mg, intensive dark color and of characteristic shape (US territory) informally called "rowisnit", preserved as exhibited.

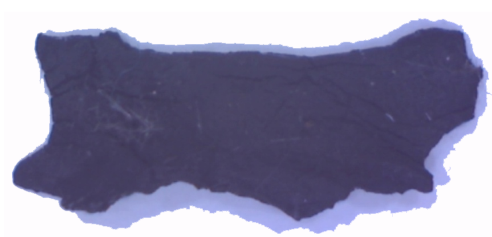

Fig. 5. Rowisnit (informal name) obtained by R. Wiśniewski, A.Yu. Didyk, T. Wilczyńska-Kitowska and G.V. Mishinsky. For more information, see the text.

4. The mechanism of production of foreign chemical elements in condensed gases

Our numerous experiments done by Didyk, Wisniewski *et al.* [1–4, 6, 9–13] at the FLNR of JINR demonstrated the feasibility of low-energy nuclear reactions. A new mechanism was proposed to explain the appearance of synthesized elements [14, 15]: low-energy multinuclear reactions. These reactions are leading to the creation of nuclear molecules, which consist of several helium nuclei $n \cdot {}^4\mathrm{He}$. Nuclear molecules are created by fusion of several orthohelium atoms formed as a result of ionization of helium atoms by gamma radiation followed by recombination of helium ions with electrons.

In our experiments, the reactions occur at pressures of hundreds and thousands of bars. Under such pressures, the density of atoms in the gas is comparable with the density of atoms in solids or liquids. Subsequently, the term condensed (dense) gas is used. Low Energy Nuclear Reactions (LENR) occur in condensed gases upon irradiation by gamma quanta. As a result of ionization by gamma quanta of condensed matter, local regions, stable, electron–ion formations — "capsules" are formed in matter with a strong magnetic field B inside "capsules" containing a large quantity of atoms inside them. The linear size of a "capsule" is estimated at 10^{-7} cm $< L < 10^{-13}$ cm [5]. LENR take place in those "capsules".

Subsequently, the transmolecules ${}^8\mathrm{Be}$ and ${}^{12}\mathrm{C}$, due to their own ultra-strong magnetic fields, will be attracted to each other, and enter into an exchange interaction with their electron Bose–Einstein condensates. This will result in formation of multinuclear transmolecules $n \cdot {}^4\mathrm{He}$ with the helium Bose–Einstein condensate (see Fig. 6 and Fig. 7). The creation of such transmolecules leads to multinuclear reactions, with the emission of protons, neutrons, alpha particles and heavy fragments, see Fig. 8; solid (green) line is a probability of $n \cdot {}^4\mathrm{He}$ - (${}^{16}\mathrm{O} \div {}^{36}\mathrm{Ar}$) formations [14]

$$n \cdot {}^4_2\mathrm{He} \;\rightarrow\; {}^{4n-1}_{2n-1}A + p + Q\,, \qquad n \cdot {}^4_2\mathrm{He} \rightarrow {}^{4n-1}_{\;\;2n}B + n + Q\,,$$
$$n \cdot {}^4_2\mathrm{He} \;\rightarrow\; {}^{4(n-1)}_{2(n-1)}C + {}^4_2\mathrm{He} + Q\,, \qquad n \cdot {}^4_2\mathrm{He} \rightarrow A + B + C + \ldots + Q\,,$$

where Q is energy released as a result of reaction. The first unstable transmolecule is oxygen — 16 (${}^{16}_{8}\mathrm{O} = 4 \cdot {}^4_2\mathrm{He}$). The carbon-producing reaction: $4 \cdot {}^4_2\mathrm{He} = {}^{16}_{8}\mathrm{O} \rightarrow {}^{12}_{8}\mathrm{C} + {}^4_2\mathrm{He} + 7.275$ MeV comes with a maximum yield (Fig. 8).

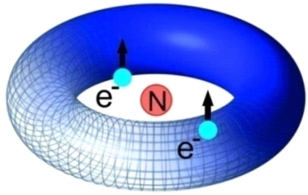

Fig. 6. Orthoboson, Transhelium.

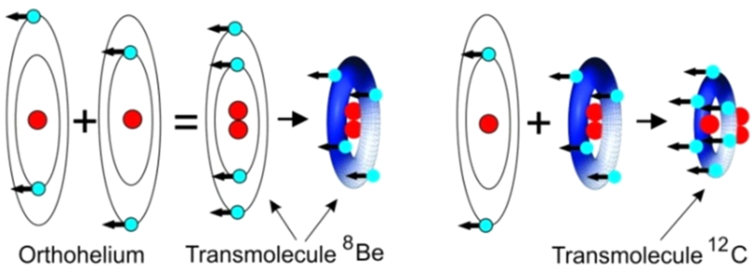

Fig. 7. Formation of transmolecules ^{8}Be and ^{12}C.

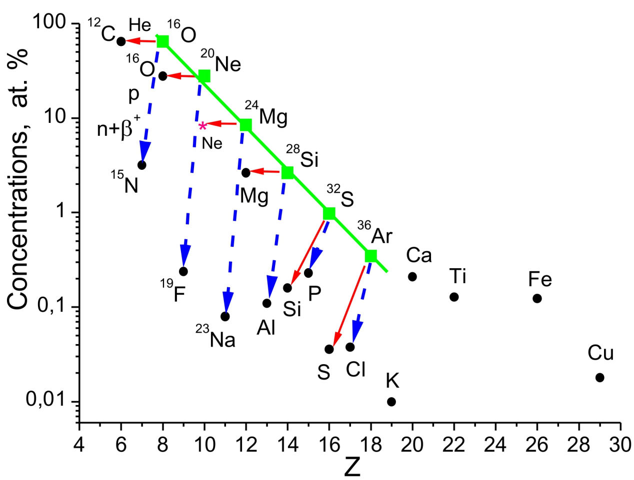

Fig. 8. Transformation of transmolecules ($n \cdot {}^{4}$He) with helium, proton or neutron emission.

5. Conclusion

Atoms of other chemical elements in the ultrastrong alternating magnetic field of the transmolecule ^{8}Be, ^{12}C *et al.* can be transformed into transatoms that enter into low-energy nuclear reactions. In experiments with other gases: hydrogen, deuterium, xenon, as well as forhelium, it should be assumed that their ionization in the condensed medium results in formation of "capsules" with a strong magnetic field inside, which leads to low-energy multinuclear reactions. A transnuclear transatom is a new state of matter: Spin-Nuclide-Electron Condensate (SNEC). The SNEC is a changed state of atomic and nuclear structure of chemical elements. The physical and chemical properties of elements change in this state. Transatoms are attracted to each other and form transmolecules with new properties that differ from those of ordinary molecules.

6. γ quanta irradiation of dense gaseous mixture of He–D_2 gases

For confirmation of the observed effects with pure He, a typical procedure of γ irradiation of dense gaseous He–D_2 mixture was used. Most probably, the localization of D atoms between He atoms makes impossible the generation of He complex (^{8}Be, ^{12}C, ^{16}O ... elements), see Fig. 7. Any other mechanisms did not take place. The pressures before irradiation and after irradiation appeared, with high accuracy, the same, Fig. 9.

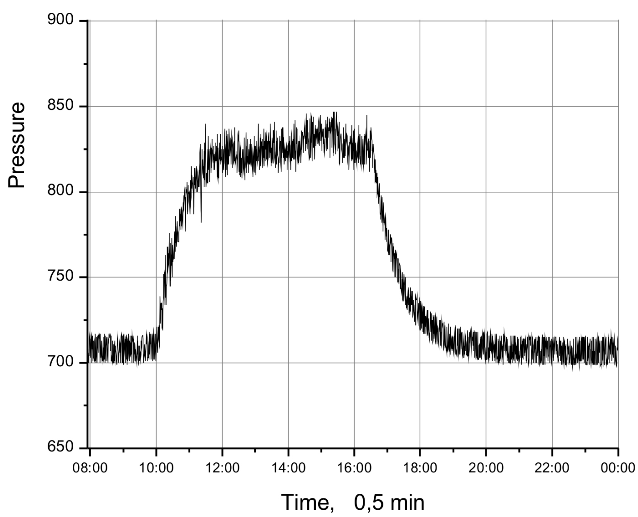

Fig. 9. Dependence of pressure changes upon irradiation time of dense mixture He–D_2. On the right, the view on experimental set. $\Delta p = 3 \times (W - W_0)$ bar where W is read-out on gauge.

In the next experiment with this set using electron irradiation of the same current intensity (20 mA), there was observed a quicker large increase of pressure and large surface changes of HPC closing elements causing, after some time, de-encapsulation of the HPC. That experiment, more precisely, will be described later [16].

7. Generation of chemical elements in experiments with dense H_2, D_2, Xe gases

During undertaken themes [1–4, 6, 9–12], analogical irradiation experiments with gases as shown in the title of paragraph, using SEM and MPRA techniques, were provided. Chemical components of different observed solids objects (not graphite-like) observed in those experiments are shown in Fig. 10. In the first diagram, there is shown a mean concentration from 28 measure-

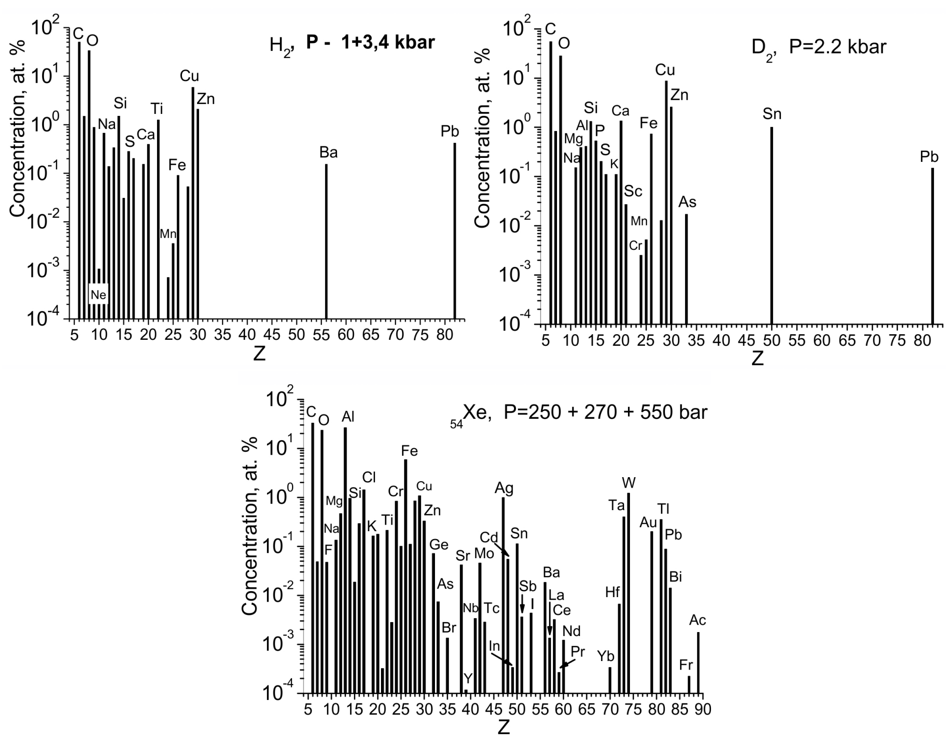

Fig. 10. Chemical components of observed solid objects after gamma quanta irradiation experiments of dense gases such as H_2, D_2, and Xe. It is necessary to pay attention to registered heavy chemical elements such as Sn, Ba, Pb, and most probably Ac.

ments for two experiments, with H_2, under pressure of 1.0 and 3.4 kbar. In the next, for one experiment with D_2 under pressure of 2.2 kbar as mean data for 42 measurements and, in the last, for three experiments with Xe — under lower pressures — 250, 270, 550 bar for 287 measurements.

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