

# NEW ROUTE OF THERMAL TRANSFORMATION OF HYDROCARBONS AND NOVEL STRUCTURES AND COMPOUNDS OF CARBON

**Kharlamov A.I.,\* Kirillova N.V., Fomenko V.V., Gubareni N.I., Skripnichenko A.V.**

Frantsevich Institute for Problems of Materials Science of NAS.

Krzhyzhanovsky St .3, 03142 Kiev, Ukraine.

\* *Факс: 38 (044) 424 2131 E-mail: dep73@ipms.kiev.ua*

The most fundamental and lasting objective of synthesis is not production of new compounds, but production of properties  
George S.Hammond  
Norris Award Lecture, 1968

Indeed, substances are a great great number (more than 4000) but properties, substances with useful properties, – almost on an order less. Therefore to get a substance with perspective property is a primary objective of chemist. (It is possible also to suppose that a nobel laureate anticipated appearance (after almost 20 years) of nanoobjects. In any case, a way to new property lies through either opening of new reactions and synthesis of great number of new substances or creation of the new states of matter (nanostructure and nanophases). Before we developed the on principle new type of reactions between solid reagents [1], such as Al, B, Si, C. By the main distinctive feature of this new type of reactions – reactions of exothermic syntheses – there is that a product is formed as nanostructures of different morphologies and their growth takes place simultaneously on the great number of the isolated nanocenters from the atoms of the sublimated powdery reagents. Due to a reaction exoeffect a temperature in a neighborhood of nanocenter considerably exceeds a middle temperature, fixed in a reactor (< 1200°C), what provides the promoted, «reactionary sublimation» of initial reagents and comparatively hasty growth of nanostructures. Most so-called solid-phase reactions, in actual fact, it is possible to carry out in the mode of reactions of exothermic nanosyntheses, the limiting stage in which will be «reactionary not diffusion», but «reactionary sublimation» of reagents. Growth of carbon (and uncarbon also) nanotubes (CN) and nanofilaments is carried out, as we suppose, also in the mode of exothermic nanosyntheses. In accordance with a polycondensation mechanism, in detail described by us in [2], the basic element of construction of carbon molecules and nanostructures is a molecule of benzene or his homologs. The particle of metal activates the molecule of benzene, apt at the increase of new C-C bonds with other molecules of hydrocarbon only. Curvature of

graphene net is created due to  $sp^3$  - hybridizations of carbon in the activated molecule of benzene.

In this report we present the new route of thermal transformation of hydrocarbons, during realization of which synthesized not only fullerenes and their hydrides but also novel substances and unique structures. Certainly, the processes of cracking and pyrolysis of hydrocarbons are explored already in detail enough. However from positions of nanochemistry as chemistry of transitional, activated complexes research of these processes begins only. (Nanochemical objects, in particular nanophases, it is possible also to characterize as the activated states in processes of macrophases forming).

At the polycondensation mechanism of growth of CN [2] a formation of carbon toroids and onions is fully logical. By the center of origin of nanospheres, undoubtedly, there is a molecule of fullerene and that is why it is possible to assume that a molecule of fullerene in the process of growth of onions from the molecules of aromatic hydrocarbons is a not so much transitional, activated complex, how many by intermediate compound. Indeed, it ensues from the experimental findings, that thermal transformation of aromatic hydrocarbons can, accompanied formation of not only CN and onions but also fullerenes and their hydrides. So in mass-spectra of the prepared tolyene filtrate (fig.1) is contained mainly fullerene  $C_{60}$ . Lines, belongings negatively and to the positively charged clusters of  $C_{56}$  and  $C_{58}$ , are distinctly present in spectra also, formation of which, possibly, is related to destruction of  $C_{60}$ . (Exactly  $C_{56}$  and  $C_{58}$ , and also  $C_{50}$ , usually fix in fullerite mass-spectra at his powerful laser treatment). However there are clusters of  $C_{52}$  and  $C_{54}$  only in negative spectrum, which before in general were not discovered. Moreover, in a negative spectrum there are lines, belongings lower, until now unknown, to the clusters of  $C_6$  and  $C_8$ , and in positive - to the clusters of  $C_6$  and  $C_7$ . Lines, which can be delivered to to fullerenes hydrides:  $C_{60}H_8$ ,  $C_{60}H_{16}$  and  $C_{60}H_{20}$ , are present in mass-spectra also.

Three groups of lines, which can be delivered to the hydrides of fullerenes  $C_{60}$ ,  $C_{70}$  and  $C_{82}$ , most interesting in mass-spectra of benzene filtrates (fig.1):

$C_{60}H_8$ ,  $C_{60}H_{16}$  and  $C_{60}H_{20}$

$C_{70}H_7$ ,  $C_{70}H_{21}$ ,  $C_{70}H_{28}$

$C_{82}H_{17}$ ,  $C_{82}H_{31}$ ,  $C_{82}H_{45}$ ,  $C_{82}H_{59}$ .

A difference between fullerenes hydrides in each of groups makes 14 units. It is possible that to

$C_{60}H_4$ ,  $C_{70}H_7$  and  $C_{82}H_3$  is added different amount of  $CH_2$  of groups or atoms of nitrogen.

As a new substance in this report we present oxinitride of graphite ( $CO_xN_y$ ), and as a unique structure is graphene-like micronet and carbon microclusters (Fig.2). Unlike the oxide of graphite ( $C_{>2}O$ ) of oxinitride as well as fluoride of graphite ( $CF_2$ ) is dissolved in water (and not only).

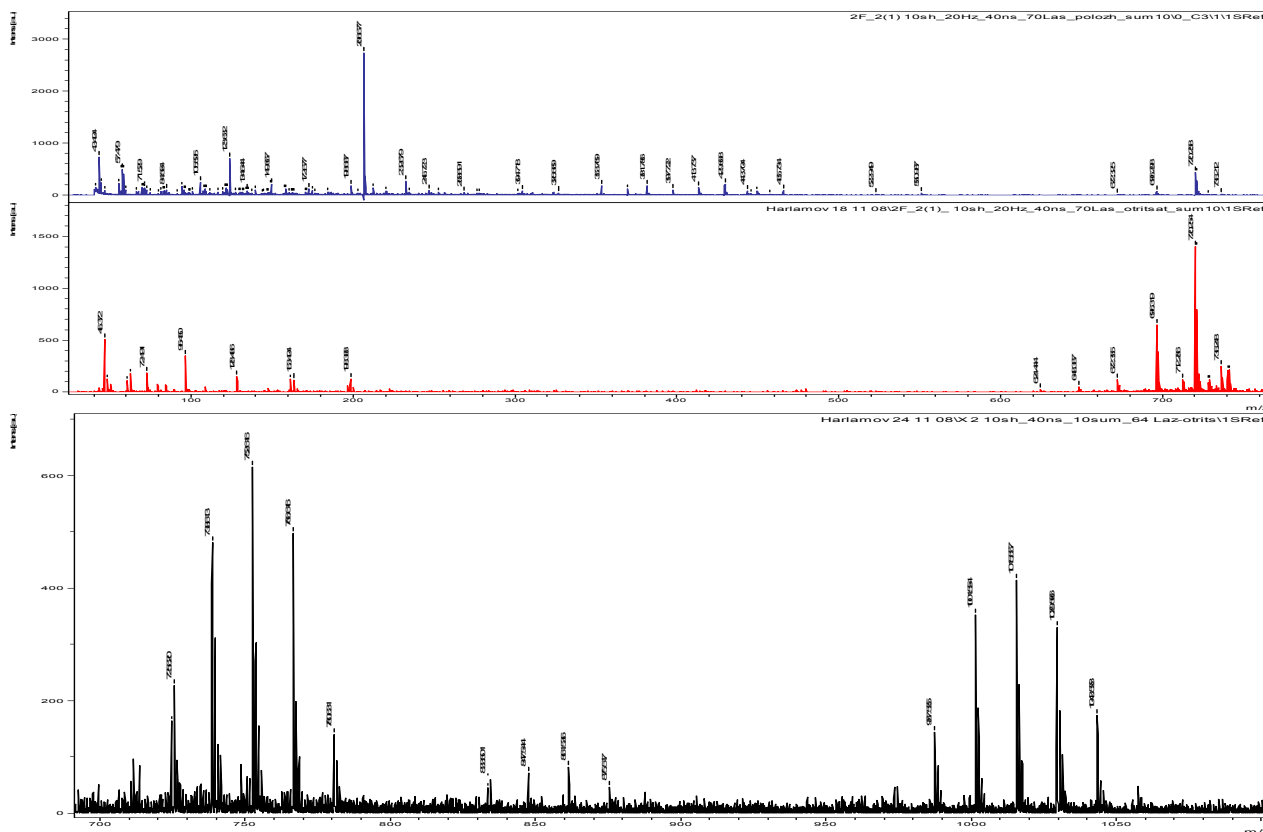


Fig. 1. Mass-spectra of extracts, got at dissolution of synthesized products.

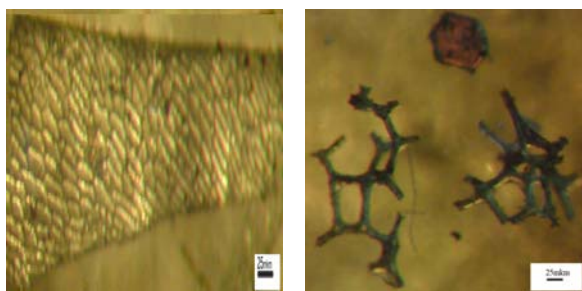


Fig. 2. Images of optical microscopy of «micrographene» net and «microclusters of carbon».

## References

- 1.Kharlamov A.I., Kirillova N.V., Karachevtsrva L.A. Low-temperature reactions between vaporizing silicon and carbon. Theoretical and Experimental Chemistry 2003;39(6): 374-379
- 2 Kharlamov A.I., Loythenko S.V., Kirillova N.V. at al. Toroidal nanostructures of carbon. Single-walled 4-,5- and 6 hedrons and nanorings. Report of Academia of Science of Ukraine 2004 (1), p.95-100