The analysis of physical phenomena determining the ignition of fuels enriched with carbon nanotubes

Nanotechnology and nanomaterials are some of the most dynamically developing areas of science and engineering today. Many of the nanomaterials invented and produced over the last dozen or so years have unique properties far different than those of standard construction materials. One such relatively recently discovered property is the ability of carbon nanotubes to ignite under the influence of light; This feature was discovered accidentally when attempting to photograph a nanotube using a regular camera with the flash function [1].

The use of carbon nanomaterials is limited, despite their extremely favorable properties and at present a relatively low price [2, 3]. In our opinion, this is due, among other things, to the fact that many of the models used in physics and chemistry need to be refined in order to properly describe the processes taking place in nano scale.

Some people claim that by dividing the material into finer pieces, we can obtain a nanomaterial at the point, when the particle sizes become so small that their new properties will be revealed. For gold, for example, if they are sufficiently shredded, they change color from golden to red – this is how glass has been stained in church windows since the Middle Ages. The science that describes the interaction of light with nanoparticles is plasmonics; This science is at the core of our project.

The aim of our project is to study the influence of carbon nanotubes dispersed in fuel on the fuel ignition and combustion process taking the emissions of toxic gases into account.

We adopt the hypothesis that a fuel in which a low concentration suspension of carbon nanotubes is formed can be ignited using laser light, and that plasmonic effects can be produced and used by using monochromatic light on homogeneous nanomaterials [4].

Our research will be on expanding the existing models describing the ignition of nanotubes as heat processes by including the phenomena characteristic of the electron cloud produced by exposing monochromatic nanotubes to coherent laser light. We also assume that the generated electric field can have a significant influence on the initiation and speed of the chemical reactions.

Technically, our task will be to produce and characterize carbon nanomaterials, to create stable nanotube suspensions in ecological fuels, and to verify the presence of plasmonic phenomena. Among many laboratory techniques we will use high resolution scanning electron microscope, Raman spectrometer, optical spectrometer, high speed photo camera and other equipment.

Literature

[1] AJAYAN, P.M., TERRONES, M., DE LA GUARDIA, A., HUC, V. et al. Nanotubes in a flash ignition and reconstruction. *Science*. 2002, 296, 705.]
[2] BAUGHMAN, R.H., ZAKHIDOV, A.A., DE HEER, W.A. Carbon nanotubes – the route toward applications. *Science*. 2002, 297, 787-792.
[3] DE VOLDER, M.F.L., TAWFICK, S.H., BAUGHMAN, R.H., HART, A.J. Carbon nanotubes: present and future commercial applications. *Science*. 2013, 339, 535-539
[4] WANG Y., PLUMMER E.W., KEMPA K.; Foundations of Plasmonics; *Advances in Physics*, Oct.2011