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WORKSHOP ON FIELD EMISSION FROM CARBONACEOUS MATERIALS

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COMBUSTION SYNTHESIS AS A SOURCE OF NOVEL CARBON-RELATED NANOMATERIALS

*A. Huczko**, *M. Soszyński*, *A. Dąbrowska*, *M. Bystrzejewski*

Laboratory of Nanomaterials Physics and Chemistry, Department of Chemistry, Warsaw University, 1 Pasteur str., 02-093 Warsaw, Poland

*ahuczko@chem.uw.edu.pl

Combustion synthesis, or self-propagating high-temperature synthesis (SHS), is a versatile and innovative technique for the production of high-tech novel materials. In this method, a sample consisting of a powder mixture of reactants is ignited at one end. A thermal wave then propagates through the sample, converting unburned starting materials to products. Specifically, due to mostly gas-phase environment and fast quench of reactants, SHS is an efficient method of synthesis of many solid products like low-dimensional nanomaterials, which are known to exhibit even more interesting properties due to the quantum confinement and size/shape effects.

We present here the results of our exploratory research on SHS production of (i) silicon carbide nanowires (SiCNWs), (ii) carbon encapsulated magnetic nanoparticles (CEMNPs) and (iii) carbon nanotubes (CNTs).

Those nanomaterials are considered as the most promising ones for the prospective applications in a modern electronics, biochemistry, environmental and materials science. Their further and wider applications will call for the mass production. Thus, the process optimization is of the highest concern. We present here the continuation of such parametric studies. SiCNWs were produced via combustion of $Si/(C_2F_4)_n$ mixtures, CEMNPs were efficiently obtained from NaN_3/C_6Cl_6/ferrocene compositions while one-dimensional nanostructures (resembling CNTs) were found in products resulting from the reduction of various carbonates with Mg.

The combustions were carried out in a high-pressure reactor (within the pressure range between 10-50 atm) either under neutral (Ar) atmosphere or in a synthetic air. The reaction was usually terminated within a fraction of second. The light emitted from the combustion zone was measured and the average reaction temperatures (1800-2000 K) were estimated. The protocols for the final separation/purification (mostly via the wet chemistry route) of the sought products were elaborated. The produced nanostructures were then characterized using XRD, SEM, TEM and Raman spectroscopy.

Finally, the formation mechanism of the obtained nanomaterials and some possible applications (e.g., as a reinforcement of composite materials and sorbents of heavy metals) are currently under investigation.

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