"Nanotechnology and nanomaterials"
Carbonaceous nanomaterials for power engineering needs

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Gas Institute of NAS of Ukraine made a series of important new researches to create technology and equipment for nanomaterials and nanofluids that can effectively be used in the newest and traditional energetics.

Scientists of the Institute carried out thermodynamic study and created a pilot unit of electrothermal fluidized bed (ETFB). ETFB – a bed of electrically conductive particles in a fluidized state heated by electric current passing through its volume. It is possible to realize various processes at extremely high level of temperature (up to 2000°C). For the benefit of microplasma charges in the created aggregate (one of the biggest in the Western Europe) it was implemented a continuous coating of pure quartz particles by lustrous nanopyrocarbon. The layer of pyrographite that capsulated quarts can be obtained in different thickness range by pyrolysis of hydrocarbons. Carbothermic reduction of silicon from quartz sand coated by pyrolytic carbon was accomplished in plasma arc discharge in the environment of vacuum with atomic hydrogen. So, we suggested to obtain pure silicon suitable for use in photovoltaic bypassing the expensive and dangerous "Siemens" chloride method.

Pilot, portable and autonomous installations to produce nanoflaky thermal expanded graphite or termoghrafenite (TRG) which have a great using potential as a supersorbent for liquidation of oil and petroleum spillages have been produced. Methods to collect spilled oil from water and soil are elaborated, as well as methods of absorbed oil utilization and TRG-sorbent regeneration. Also, Gas Institute has designed and manufactured equipment to obtain pure TRG, which has significant prospects for use as additive to the electrodes of automotive lithium-ion batteries.

Nowadays the Gas Institute is elaborating an advanced technology, energy efficient equipment and pilot production of high quality low ash activated carbon on the base of bio raw material (shells of coconut and walnut, apricot seeds, etc) with specific surface area near 2000 m^2/g. Such carbon nanomaterial is very perspective for creation a newest source of electric current: lithium and zinc air batteries, supercapacitors.

On the basis of fundamental research there were obtained experimental batches of multi-wall carbon nanotubes (MWCNTs), regarded as one of the most promising materials for hydrogen storage.

Multi-year experimental and theoretical studies carried out in the field of disperse metals obtaining with pre-specified carbon value are underlaid at the basis of the developed technology of carbon nanotubes manufacturing. Thermodynamic

modelling of phase formation while hydrocarbons catalytic decomposition is based on the software products: «GaS» and «Terra». As a result, at present, the Gas Institute has a range of the equipment allowing a deep investigation of methods to produce carbon nanotubes and catalysts for their formation.

For the first time in the NIS the systematic study devoted to the preparation of stable nanofluids was carried out using TRG, MWCNTs and Ukrainian aluminosilicates. There were developed thermal physics foundations and computerized unit for the study of heat flow in nanofluids. It was found that nanofluids have increased by 20-30% a thermal conductivity. Nanofluids using in systems with a coolant boiling can in 2-3,5 times rise a critical heat flux.

Also, we performed researches devoted to the stabilization of aqueous suspensions containing MWCNTs and TRG using a wide range of stabilizers of different classes. Due to the hydrophobic nature of the MWCNTs and especially of the TRG they are difficult to stabilize. Nevertheless, our experiments allowed us to determine and select the most appropriate stabilizers of MWCNTs and TRG.