SCO-Young Scientist Profile

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Details of research work carried out in S&T

Natural gas methane and hydrogen are promising fuels for the global clean energy, which have several advantages over fuels produced from liquid hydrocarbons and coal, due to their energy efficiency and environmental friendliness. It is known, that these energy carriers are capable of covering a wide range of energy tasks, from small power systems of drones and portable energy sources to gasification of vehicles, autonomous gas supply and strategic reservation of gas fuel in especially large volumes.

The main obstacle to wide use of these resources is their low bulk density under normal conditions, which requires special technological measures - the compression to high pressures or liquefaction at cryogenic temperatures. Storage of gases in adsorbed state is an effective alternative to mentioned technologies. The method is based on usage of a special porous materials (adsorbents) with ultranarrow pores, which paly the role of nano-compressors and provide high density state of adsorbed gas molecules, comparable with that for liquid. It should be noted this technology is applicable for all the range of gas-power systems, it possesses higher fire and explosion safety and energy efficiency due to lower operation pressures.

In the frames of the research, fundamental basis for gas storage in adsorbed state using nanoporous adsorbents with tailored porous structure has been developed. Adsorption simulation studies were employed for prediction of adsorption and thermodynamic behaviors of novel adsorption systems. New classes of carbon, metalorganic and composite porous materials have been designed with possibility of upscale production and real implementation. New materials were experimentally tested on adsorption capacity, cyclic stability, mechanical strength.

Prototypes of gas storage systems for gas-powered vehicles and mobile gas supply have been successfully developed and tested. Specific storage gas capacity of innovative systems exceeds 220 m^3(gas STP)/m^3(system) at pressures up to 10 MPa, which allows to increase refueling interval and decrease final gas cost for consumer.

Associated SCO-YSC Theme: **Sustainable Energy and Energy Storage**

Shanghai Cooperation Organization- 1st Young Scientists Conclave (SCO-YSC 2020)
A virtual event organsied in India at CSIR-IICT, Hyderabad
Theme: **Shaping SCO-STI Partnership: Young Scientists Perspectives**

Statement of Innovation

Innovative technology for natural gas and hydrogen storage in an adsorbed state, where a special nanoporous material is used as a carrier of gas molecules, which has a high adsorption activity to these gases. The pores of such a material are commensurate with gas molecules, and therefore a high interaction energy in the "gas-adsorbent" system occurs, which provides high density state of gas molecules inside the pores, called nano-dispersed state. The special properties of the material make it possible to concentrate gas with an extremely high density even at relatively low pressures (1-10 MPa), which makes this method of gas storage safer and more energy efficient.

The developed technology does not require the creation of cryogenic temperatures or the use of additional means for filling or extracting gas, no heavy thick-walled vessels are required, and the gas accumulator design can be flexibly optimized for a specific task.

Major awards/ Achievements

- Certificate of Appreciation "For top achievements and results of R&D in the field of the adsorption natural gas technology", IPCE RAS, Moscow, 2019.
- Diploma "For the best presentation". All-Russian symposium with international participation "Physicochemical problems of adsorption in nanoporous materials", Moscow, 2018.
- First place award. The XI competition of the projects of young scientists in the frames of the International exhibition on chemical science and industry "Chemistry-2017", Moscow, 2017.

Possible collaboration with SCO countries

- Conversion from gasoline and diesel transport to natural gas and hydrogen-powered vehicles using adsorption technique.
- Development of mobile natural gas supply systems based on adsorbed natural gas technology for energy supply to remote consumers, small settlements, and non-gasified objects.
- Development of reserve gas storage systems of high capacity for peak shaving of increased gas consuming.
- New hydrogen adsorption storage systems for new generation of unmanned aircrafts and drones, operation on fuel cells and hydrogen-combustion engines.

Key words

- clean energy
- natural gas storage
- gas-powered transport
- nanoporous materials
- adsorption