REVIEW

from scientific supervisor, PhD Yerlan Doszhanov on doctoral dissertation of Assem Zhumagaliyeva «Production and testing of carbonized rice husk-based nanocomposites for capturing of carbon dioxide» provided for the degree of Doctor of Philosophy PhD in specialty 6D074000 - «Nanomaterials and nanotechnology»

The PhD thesis of Assem Zhumagaliyeva devoted to the investigation of synthesis carbon-based nanostructured composite materials and following testing adsorption features of carbon dioxide in post-combustion flue-gas condition.

Experimental section describes methods of synthesis carbon based nanocomposite materials for CO_2 adsorption and methods of its characterization. Also this part include investigation modes of obtained materials for indicate CO_2 sorption characteristics. Chapter 2.1 reported carbonization process of rice husk, which was used as carbon matrix in nanostructured composite materials. In Chapters 2.2-2.4 introduce description of receipt process of composite based on carbonized rice husk and magnetite nanostructured particles, composites based on carbonized rice husk and nanoparticulate magnetite and composites based on carbon black and nanoparticulate magnetite. Either describe of base-leaching methods to obtaining CO_2 adsorbents by base-leaching process in different conditions. For study of synthesized materials used physic-chemical methods of analyses, such as EA, ICP-MS, TGA, XRD, SEM, AFM, FTIR, BET. CO_2 adsorption characteristics measured by static fixed-bed Pyrex micro-reactor included infrared gas analyzer.

In third part of thesis presented results and discussion: 3.1 Characterization of carbon based nanocomposite materials for CO_2 adsorption; 3.2 Investigation of CO_2 sorption characteristics of carbon based nanocomposite materials; 3.3 Overview on the obtained analysis of carbon-based nanocomposites for CO_2 capture technology.

Importance of the work obtaining carbon-based nanocomposite materials and establish the influence of the preparation conditions on their physicochemical and adsorption properties.

To achieve the goal it is necessary to solve the following tasks:

1. To obtain carbonized rice husk (cRH) using as a carbon matrix in solid sorbents for CO_2 capture. To investigate structural and physical properties of obtained cRH.

2. To modify cRH with magnetite fine particles (FM) by co-precipitation method and study physicochemical characteristics of cRH-FM based composites. Testing sorption capacity of cRH-FM based composite by using statistic fixed-bed micro-reactor.

3. To synthesize nanoparticulate magnetite (nFM) for cRH-nFM and Carbon Black (CB) -nFM series composite materials, following used as a sorbents in post-combustion flue-gas condition. To analyze adsorption features and structural relation of synthesized composites.

4. To determine the optimal parameters of cRH alkali treatments, to investigate dependence CO_2 adsorption capacity of structural characteristic in alkali-treated cRH.

Results of CO_2 uptake capacity in post-combustion flue-gas conditions of composite based on cRH and nFM (cRH-nFM) increased up to 15.55 mg/g in set 67:33 accordantly. Determined significant increment of surface area up to 271 m^2/g, homogenous pore distribution in range 2-6 nm. It has been defined that the interdependence between the specific surface area, volume of micropores and the electrochemical characteristics of the obtained alkali treated cRH materials is not directly proportional.

By her research work, Assem Zhumagaliyeva has proved herself to be a highly motivated and committed young scientist who has versatile skills in nanotechnology, physics and chemistry. Furthermore, she has clearly shown to work independently and to be capable of planning and performing complex experiments as well as of interpreting the results and findings appropriately. I think that A. Zhumagaliyeva, who has carried out her dissertation work on an urgent and topical theme at the interface of physics and chemistry, has an excellent perspective both as a young researcher and a versed nanotechnologist. Her findings are of general significance – in theory and practise – for modern nanotechnology and the manuscript meets all the requirements of a PhD thesis. Thus all in all, I have no hesitation in recommending A. Zhumagaliyeva for a doctoral degree.

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РАСТАЙМЫН
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