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Smart functional adsorbents: A harmonization approach

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Adsorption phenomena are known from ancient times and still attract increasing attention for both industrial processes and everyday life. By now, numerous technological applications of adsorbents (gas/liquid separation/purification, gas storage, heat transformation, drug delivery, life support systems on a spacecraft, air conditioning, etc.) are quite advanced. Nevertheless, there is still a big room for their further improvement. In our opinion, the main direction of this improvement could be related to harmonization of the adsorbent with the specific process.

Two ways of the harmonization are considered: (a) screening of already available adsorbents to select one, the properties of which fit better (even if not perfectly) the particular adsorptive process and (b) nanotailoring of a novel adsorbent with predetermined properties adapted to the given process. The main idea of the latter approach is that for each adsorptive technology (process, cycle) and its particular conditions there is an optimal adsorbent (OA), the properties of which could enable perfect performance of this process or cycle.

Here, we first analyze what exactly the OA is. Quantitative requirements to the adsorbents optimal for several selected applications (gas drying, heat transformation/storage, maintaining relative humidity in museums, shifting equilibrium of catalytic synthesis, extraction of water from atmospheric air) are formulated in terms of the Dubinin adsorption potential and isobar shape. Then, we briefly consider how to synthesize a real material with adsorption properties close to those of the OA. Metal-organic frameworks, aluminophosphates and composite sorbents "salt in porous matrix" are considered as examples.

Biography

Yuri Aristov is a Professor of physical chemistry and the head of the Group of Energy Accumu-lating Materials and Processes at the Boreskov Institute of Catalysis (BIC), Novosibirsk, Russia. He received his MSc degree from the Moscow Physico-Technical Institute in 1977, and his doctoral and habilitation degrees from BIC (1984 and 2003). He contributed to the fields of radiation chemistry, low-temperature electron tunneling, fractal analysis of porous solids, and thermochemical transformation of heat. He is currently working on novel composite adsorbents for adsorptive chilling, gas drying, and maintaining relative humidity in museums. He has published 1 monograph, 200 papers, and 26 patents.

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