Subarea POB3: Advanced methods of material surface modifications.

Title of the presentation: Modern materials in heterogeneous catalysis

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Abstract:

Surface engineering at the atomic scale is used to produce efficient and selective catalysts. A catalyst is a substance that increases the rate of a chemical reaction, is not consumed in the catalyzed reaction, and can continue to act repeatedly. Catalytic reactions are particularly important for energy conversion processes. They are a pillar of sustainable and clean energy, thanks to which it will be possible to increase its renewable resources and reduce environmental pollution.

The best known catalysts include noble metals such as Pt, Ru and Pd, but none of them work perfectly for all reactions and the high cost and limited resources inhibit their large scale use. Despite considerable efforts with base metal catalysts, the results achieved so far are still insufficient, although progress has been made steadily. Therefore, nanomaterials based on noble metals in the form of nanoparticles deposited on a suitable support with a large specific surface area remain the leading direction of research. Decisive for the performance of the catalysts is the fact that only the exposed surface atoms can serve as active sites, while the internal atoms do not participate directly in the catalytic reaction.

To enable more atoms to participate in the designed catalytic reaction, an obvious approach is to reduce the sizes of the catalyst. Along with the constant reduction of the size of the active material, the share of exposed atoms on the surface increases significantly, and additionally the electronic properties change, affecting their chemical activity. Catalyst surface engineering can dramatically change the activation energies of basic process steps, resulting in an increase or decrease in the rate of reaction. Additionally, the control of the support surface makes it possible to increase the durability of the catalyst. Therefore, the determination of the relationship between the surface structure (catalyst, support) and catalytic activity is of key importance for the production of modern catalysts.