Hybrid BN/Au and BN/Pt nanoparticles development as promising catalysts

Andrey Kovalskii[1], Andrei Matveev[1], Ilia Volkov[1], Denis Leybo[1], Anton Konopatsky[1], Dmitry Shtansky[1], Dmitri Golberg[2]

[1] National University of Science and Technology "MISiS", Leninsky prospect 4, Moscow, 119049, Russian Federation,
[2]Science and Engineering Faculty, Queensland University of Technology, 2nd George st., Brisbane, QLD 4000, Australia
Contact@E-mail: andreykovalskii@gmail.com

INTRODUCTION

h-BN nanostructures are in focus due to a rare combination of properties. This nanostructures are considered as the key components of the next generation of advanced catalysts. The question of present interest is the development of high yield approaches for synthesis of hybrid BN/Au and BN/Pt nanoparticles for promising catalysts.

EXPERIMENTAL STUDY AND RESULTS

Different strategies of CVD process were developed for obtaining a variety of BN nanoparticles. Spherical BN nanoparticles with an average external dimensions of 80-150 nm having hollow and solid cores and smooth and petalled surfaces were synthesized using precursors on the base of FeO, MgO, SnO, H_3BO_3 and B, various temperatures and flow rates of argon and ammonia. Changing the experimental conditions affects the particle morphology, oxygen content and the product yield. The particular mechanism for each particle morphology appearance was uncovered.

BN nanoparticles composed of numerous curved nanosheets were utilized as a new catalyst support. BN/Au hybrid nanoparticles were synthesized by chemical deposition from gold chloride acid solution followed by reduction the metallic phase and also via CVD method. BN/Pt nanohybrids were obtained by chemical deposition from platinum hydrochloric acid solution followed by reduction in hydrogen flow at T=350°C. It was shown that metal nanoparticles are evenly distributed over the surface of ceramic particles and the size of metal particles does not exceed 10 nm.

Catalytic properties of nanohybrids of BN/Au and BN/Pt systems were investigated for the reaction of carbon monoxide oxidation. Synthesized hybrid nanomaterials have pronounced catalytic properties in the ratio of carbon monoxide. The best result is shown for the catalyst BN/Pt - the beginning of the conversion process was observed at a temperature of about 150°C and the temperature of the total conversion of CO was 184°C.

ACKNOWLEDGMENTS

The work was supported by the Ministry of Education and Science of the Russian Federation (NUST "MISiS" program K2-2017-082) and RFBR grant 18-58-53034 SFNSC.