Catalytic Hydrogenation of Quinoline on Composites of Graphene-like Carbon and 3D-metals or Their Oxides.

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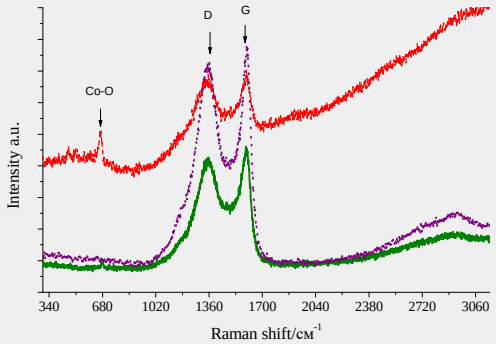
Introduction and Aim

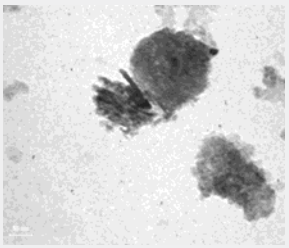
The aim of this work was to study the influence of the composition and structure of composites of graphene-like carbon and nanosized 3d-metals or their oxides deposited on the different carriers on their catalytic activity in quinoline hydrogenation.

The nanocomposites of were prepared by pyrolysis Co(II), Ni(II), Zn(II) complexes with N-containing organic ligands (phenantroline, melamine, o-phenylenediamine) on aerosil (highly disperse SiO_2), ZrO_2, Al_2O_3, activated carbon. It was shown by transmission electronic microscopy that the nanocomposites contained carbon species with size of separate particles ca. 10-50 nm. Analysis of the Raman spectral data allowed to conclude that the graphene-like particles had more than 8 carbon monolayers. The size of carboneous particles, separated from the carrier, was in range from 80 to 120 nm according to the results of dynamic lights scattering in suspension.

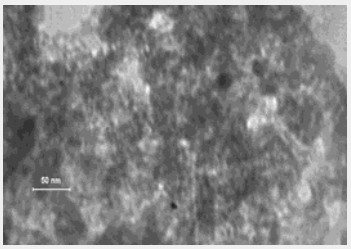
The obtained nanocomposites were catalytically active in hydrogenation of quinolines and isoquinolines to 1,2,3,4-tetrahydroderivatives **2a,b**. Under 100 atm pressure and 100ºC temperature the yield of tetrahydro(iso)quinoline varied from 40 to almost 100 % depending on the composite. The tolerance to functional groups was also researched and discussed. Catalytic activity essentially depended on synthetic conditions (mainly pyrolysis rate) and the nature of the carriers. The Co-containing composites deposited on aerosil or ZrO_2 were the most active. Catalytic activity essentially increased at decreasing pyrolysis rate, as well as at increase of Co content.



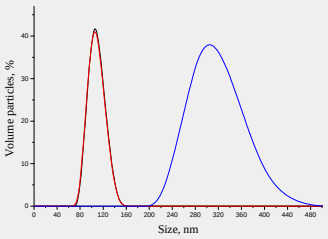
Raman spectra of nanocomposite $Co/C/Al_2O_3$. Graphene-like components of obtained composite consist of more than 8 carbonic monolayers.



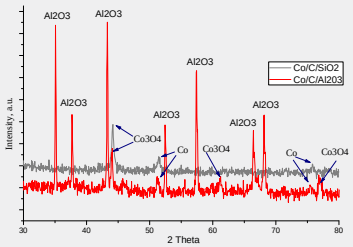
TEM image of nanocomposite $Co/C/Al_2O_3$. Graphene-like components form nanosheets



TEM image of nanocomposite $Co/C/SiO_2$

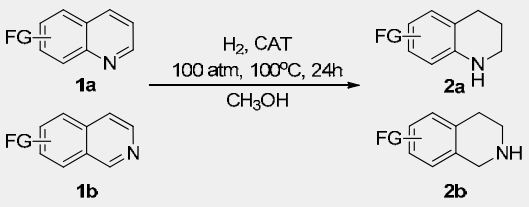


Dynamic lights scaterring spectra of graphene components of the nanocomposite $Co/C/SiO_2$ (sample obtained after dissolution SiO_2 in HF).
It was shown that their size was in range from 80 to 120 nm, and the aggregates of such particles with size up to a few hundred nm were also detected.

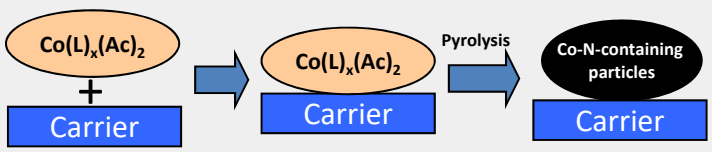


Powder XRD pattern of nanocomposites $Co/C/SiO_2$ and $Co/C/Al_2O_3$. Reflexes of mainly cobalt oxide and metallic cobalt were found

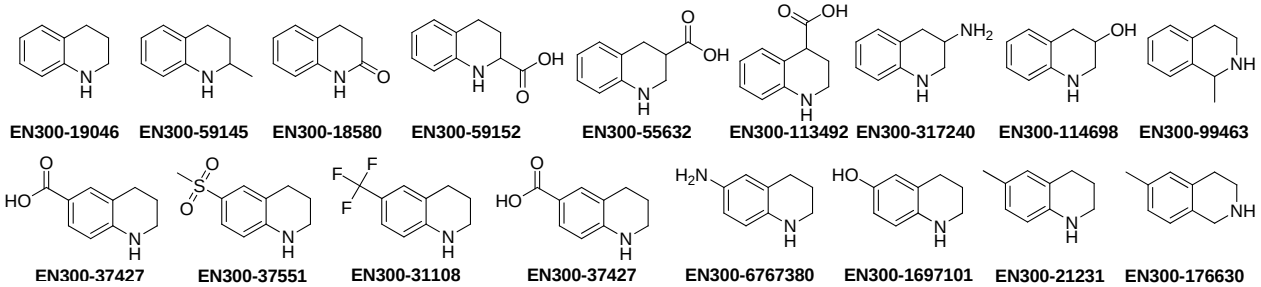
Synthesis



Catalyst producing



Results



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