Brief information about the project

Name of the project	AP14870308 "Development of technology for catalytic petrochemical synthesis of oxygen-containing compounds from aromatic hydrocarbons in the presence of nanoscale magnetic composites"
Relevance	The Republic of Kazakhstan has an oil refining industry. In addition to the production of various types of liquid fuels, oils and tar-asphaltene components, there is a question of obtaining oxygen-containing compounds that are used as solvents, starting materials for numerous organic syntheses, as monomers in the production of polymer materials, dyes, synthetic fibers, medicines, raw materials for synthetic detergents, flavors, surfactants, etc. Therefore, the development of obtaining oxygen-containing compounds from hydrocarbons using nanoscale magnetically controlled composites deserves the closest attention. Such catalytic systems make it possible to carry out the process of oxidation of hydrocarbons under mild conditions in the liquid phase. However, there are still no studies whose results bring together the basic patterns of catalytic reactions involving hydrocarbons of various structures and their oxygen-containing derivatives, which are widely used in many sectors of the national economy. The syntheses of oxygen-containing compounds are multistage and time-consuming, and additional purification is required to obtain the target products. The project will develop nanoscale magnetic composites of transition metals immobilized on a polymer matrix. Such catalysts have a large surface area, ease of separation from the reaction mixture, and their activity and selectivity can be controlled by a magnetic field.
Purpose	The aim of the project is to develop the technology of catalytic petrochemical synthesis of oxygen-containing compounds from aromatic hydrocarbons in the presence of nanoscale magnetic composites stabilized by polymers.
Objectives	1. Preparation of nanoscale magnetic composites based on Fe_3O_4, $CoFe_2O_4$ immobilized on chitosan and polyvinylpyrrolidone by chemical deposition or mechanochemical synthesis. 2. Study of phase state, structure and size distribution of obtained nanomaterials and their composites. 3. Characterization of magnetic parameters of the obtained hybrid materials (coercive force, saturation magnetization, etc.). 4. Optimization of magnetic composite compositions for aromatic hydrocarbon oxidation (phenol, p-xylene). Detailed study and quantitative description of oxidation kinetics of aromatic hydrocarbons with oxygen in the presence of developed nanoscale magnetically controlled composites. 5. Development of hardware and process diagram, technological regulations for production of functional hybrid materials. 6. Provision of recommendations on use of results of catalytic petrochemical synthesis of oxygen-containing compounds from aromatic hydrocarbons on magnetic composites.

Expected and achieved results	The following results have been achieved and are expected within the framework of the project: • Nanoscale magnetic composites of iron and cobalt stabilized with natural (chitosan) and synthetic (polyvinylpyrrolidone) polymers have been obtained. • Modern physicochemical methods (RFD, scanning electron microscopy, BET, elemental and chemical analysis) establish the composition and structure of the resulting composites. With the help of Mössbauer, EPR, IR spectroscopy, the composition, oxidative state of the metal established, using a magnetometer and hysteresisograph, the magnetic properties of the obtained magnetic composites studied. • In the vortex mode, under thermostatic conditions, the kinetics of oxidation of phenol with oxygen in the presence of developed nanoscale magnetically controlled composites in the magnetic field and without it will be studied in detail and quantified. • In the vortex mode, under thermostatic conditions, the kinetics of oxidation of paraxylene with oxygen in the presence of the developed nanoscale magnetically controlled composites in the magnetic field and without it will be studied in detail and quantified. • The process parameters of production will be optimized, as well as tests of the activity and selectivity of the developed catalysts in the process of oxidation of phenol (TMP) with oxygen and oxidation of paraxylene will be carried out. A process diagram and process regulations for the production of catalytic composites will be developed.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	1. Shakiyeva T.V. candidate of chemical Sciences, h-index – 4. Scopus author ID: 55911739700. ORCID ID: ID: 442x 2. Dossumova B.T. candidate of chemical Sciences, h-index – 3. Scopus author ID: 57210592713. ORCID ID: https://orcid.org/0000-0003-4126-2907. 3. Sassykova L.R., candidate of chemical Sciences, h-index – 15. Scopus Author ID: 56178673800. ORCID ID: https://orcid.org/0000-0003-4721-9758 4. Baizhomartov B.B. PhD, h-index – 3. Scopus author ID: 55911449500. ORCID ID: https://orcid.org/0000-0002-3221-114x. 5. Dzhatkambaeva U.N. master's degree, h-index – 3. ORCID ID: https://orcid.org/0000-0001-8216-3206 6. Ilmuratova M.S. h-index – 1. Scopus Author ID:57262368200. ORCID ID: https://orcid.org/0000-0001-7773-6057
List of publications with links to them	1. L. R. Sassykova, B.T. Dossumova, M. Ilmuratova, T. V. Shakiyeva, B. B. Baizhomartov, A. R. Sassykova, Zh. M. Zhaxibayeva, T.S. Abildin. Development of nanostructured catalysts for catalytic oxidative water purification from organic impurities, including phenolic compounds //Chimica Techno Acta 2023, vol. 10(3), No. 202310309. DOI: 10.15826/chimtech.2023.10.3.09 2. B.T. Dossumova, L. R. Sassykova, T. V. Shakiyeva, M. S. Ilmuratova, A.R. Sassykova, A.A. Batyrbayeva, Zh. M. Zhaxibayeva, U.N. Dzhatkambayeva and B.B.Baizhomartov

	Catalysts Based on Nanoscale Iron and Cobalt Immobilized on Polymers for Catalytic Oxidation of Aromatic Hydrocarbons: Synthesis, Physico-Chemical Studies, and Tests of Catalytic Activity//Processes 2024, 12(1), 29; https://doi.org/10.3390/pr12010029.
Patents	-