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Review

From foreign scientific advisor

To the Ph.D. thesis of Toleutay Gaukhar «Physico-chemical, complexation and catalytical properties of linear and cross-linked polyampholytes» submitted for a requirement of a PhD degree in Chemical technology of organic substances (specialty of 6D072100).

The Ph.D. thesis of **Toleutay Gaukhar** is focused at the synthesis of strongly charged linear and crosslinked polyampholytes, the fundamental studies of the polyampholytes at the isoelectric point where the amphoteric macromolecules are electroneutral and are in the collapsed state, as well as at the study of the complexes of polyampholytes and of their catalytical properties, at the production of highly elastic and soft chemically crosslinked strongly charged polyampholyte hydrogels.

Linear and crosslinked amphoteric macromolecules can adopt globular, coil, helix or expanded conformations and demonstrate coil-globule, collapsed-expanded volume transitions dependent on pH, temperature, ionic strength, and thermodynamic quality of solvents. These transitions are interesting from scientific and practical points of view. That is why polyampholytes fall within the eyeshot of several disciplines, at least

polymer chemistry and physics, molecular biology, colloid chemistry, coordination chemistry, and catalysis. Complex formation of polyampholytes with surfactants, dyes, and organic ions gives an insight into the problems of complementarity of macromolecules and molecular recognition.

Hydrophobically modified polyampholytes containing hydrophobic moieties at the side chain or in the polymer backbone are able to self-assembly into micelles, vesicles, lamellar aggregates, and so on. They have already found applications including immobilization of metal catalysts, enhanced oil recovery, as pour point depressants and as wax deposition inhibitors, for the cryopreservation of living cells, and drug/gene/protein delivery. However, the literature, including patent on the production and properties of linear and cross-linked polyelectrolytes is rather limited. So, the topic if the thesis is important both from fundamental and practical viewpoints.

The thesis is clearly written and well organized. The literature review presents a comprehensive overview showing the advantages and drawbacks of the existing materials and technologies .

The experimental part of the work is novel and inventive. Gaukhar has developed an original method of the synthesis of linear and crosslinked polyampholytes based on 2-acrylamide-2-methylpropane-1-sulfonic acid sodium salt (AMPS) and (3-acrylamidopropyl) trimethylammonium chloride (APTAC) which have been used as cationic and anionic monomers, respectively. The phase transitions, collapsed-expanded volume changes in dependence of pH, temperature, ionic strength of the solution were demonstrated for these polyampholytes.

For the first time, the hydrophobically modified physical polyampholyte hydrogels were produced via micellar polymerization of AMPS and APTAC in the presence of the hydrophobic monomer, n-octadecyl acrylate. Physical PA hydrogels were produced without chemical cross-

linker. These hydrogels combine high mechanical strength and elasticity with self-healing ability.

The flow-type catalytic reactor based on macroporous amphoteric cryogels was developed and the catalytic hydrogenation of nitro aromatic compounds was studied.

The results of the work were published in 18 publications: 3 publications in journals included in the Scopus database, 2 publications approved by the Committee for Control in the Field of Education and Science of the Republic of Kazakhstan and 12 abstracts at international and national symposia and conferences, 1 innovative patent of the Republic of Kazakhstan was submitted.

This Ph.D. thesis meets all the requirements and is recommended for the defense.Toleutay Gaukhar deserves the Doctor of Philosophy (PhD) degree in Chemical technology of organic substances (specialty of 6D072100).

Foreign co-supervisor

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