

ISSN 1070-3632, Russian Journal of General Chemistry, 2018, Vol. 88, No. 11, pp. 2359–2367. © Pleiades Publishing, Ltd., 2018.

Original Russian Text © M.R. Ibatullina, E.P. Zhil'tsova, S.S. Lukashenko, A.D. Voloshina, A.S. Sapunova, O.A. Lenina, I.R. Nizameev, M.P. Kutyreva, L.Ya. Zakharova, 2018, published in Zhurnal Obshchei Khimii, 2018, Vol. 88, No. 11, pp. 1883–1892.

Dedicated to the 115th anniversary of B.A. Arbuzov's birth

Metallomicellar Systems Based on the Complexes of 1-Hexadecyl-4-aza-1-azoniabicyclo[2.2.2]octane Bromide with Transition Metal Nitrates

M. R. Ibatullina^{a*}, E. P. Zhil'tsova^a, S. S. Lukashenko^a, A. D. Voloshina^a, A. S. Sapunova^a, O. A. Lenina^a, I. R. Nizameev^b, M. P. Kutyreva^c, and L. Ya. Zakharova^a

^a A.E. Arbuzov Institute of Organic and Physical Chemistry, FRC Kazan Scientific Center, Russian Academy of Sciences, ul. Akademika Arbuzova 8, Kazan, Tatarstan, 420088 Russia

*e-mail: marina_ibatullina@mail.ru

^b Tupolev Kazan National Research Technological University, Kazan, Tatarstan, Russia

^c Butlerov Chemical Institute, Kazan (Volga Region) Federal University, Kazan, Tatarstan, Russia

Received September 6, 2018

Abstract—Potentiometry, fluorimetry, dynamic light scattering, and transmission electron microscopy were used to study the aggregation properties of the complexes 1-hexadecyl-4-aza-1-azoniabicyclo[2.2.2]octane bromide with transition metal nitrates [Cu(II), Ni(II), Co(II), and La(III)]. The critical micelle concentrations, aggregation numbers, the degree of counterion binding to micelles, the size of aggregates, and electrokinetic potentials were determined. The complexes exhibited a high antimicrobial activity, and some of them proved to be more potent than the reference drugs.

Keywords: monoquaternized 1,4-diazabicyclo[2.2.2]octane, complexes, surfactants, aggregation, biological activity

DOI: 10.1134/S107036321811018X

Metal-containing surfactants are amphiphilic compounds having not only ordinary, but also specific properties. Like traditional surfactants, amphiphilic metallocomplexes characteristically reduce surface tension, form self-assembled structures at critical micelle concentrations (CMCs), have diverse morphologies, and are stable compounds [1]. However, metal imparts to them enhanced redox activity [2], magnetic properties [3], enhanced catalytic and biological activities, cytotoxicity and ability to bind to DNA [4–7]. Due to this, metallosurfactants have found application in such fields as magnetic resonance imaging [8], thin-film optoelectronics [9], interface photophysics and homogeneous catalysis [10, 11], templating of mesoporous materials [12], directed synthesis of nanoparticles [13], etc.

The practical potential of amphiphilic metallocomplexes and systems therefrom is much dependent not only on the type of the metal [1], but also on the nature

of the ligand. Among the great diversity of structures, the complexes having cationic surfactants as ligands occupy a special place. As known, cationic surfactants are used as carriers for hydrophobic substances (including drugs), catalysts, corrosion inhibitors, sensor molecules in pharmacy and diagnostics, emulsion stabilizers, and nanocoatings [14–16]. Furthermore, much research effort is presently focused on the use of cationic surfactants as gene carriers and participants of lipoplex formation, anticancer substances, as well as components of compositions for oil well stimulation [17, 18]. All this makes cationic surfactants promising candidates for complex formation with metals.

The objects of our study are novel metallo-surfactants formed by the monoalkylated (hexadecyl) derivative of 1,4-diazabicyclo[2.2.2]octane (ligand **1**) and transition metal nitrates [Cu(II) (**2**), Ni(II) (**3**), Co(II) (**4**), La(III) (**5**)] with surfactant:metal ratios of 2 : 1, 1 : 1, 1 : 1, and 2 : 1, respectively.