Ferromagnetic nanoparticles and their functionalization with 1,4-DHP derivative

Oksana Petrichenko[1,2], A.Cēbers[1] Karlis Pajuste[2], Aiva Plotniece[2], Velta Ose[3]

[1]Laboratory of Magnetic Soft Matter, Department of Physics, University of Latvia, Zeļļu St. 8, Riga, Latvia, LV-1002

[2]Latvian Institute of Organic Synthesis, Aizkraukles str. 21, Riga, LV-1006, Latvia

[3]Latvian Biomedical Research and Study centre, Ratsupites str. 1, Riga, LV-1067, Latvia

e-mail: oksana.petricenko@lu.lv

Presently, there is worldwide interest to the functionality of magnetic nanoparticles (NPs) applied in biomedicine. Due to their biocompatibility, iron oxides are mostly studied magnetic materials applied in this field. There are several types of iron oxides in nature; they are easy to produce under laboratory conditions, yet only maghemite – γ-Fe_2O_3 and magnetite Fe_3O_4 satisfy all necessary requirements for biomedical and bioengineering applications. Among the advantages, it can be mentioned the large enough magnetic moment, chemical stability in physiological media and low toxicity as well as the easy and non-consuming process of material production. In this work, we demonstrate the produced ferromagnetic nanoparticles[1] functionalization using a new lipid-like compound – cationic pyridinium amphiphiles derived from 1,4-dihydropyridine as a liposome-forming. 1,4-DHP derivative **1** (see Fig. 1) forms liposomes and efficiently acts as gene delivery agent.[2,3] The research deals with determination of optimal conditions for the production of magnetoliposomes using a 1,4-DHP derivative **1**. The following methodology, such as sonication, spontaneous swelling (SpSw)[4] and reverse-phase evaporation (REV)[5] were used for the formation of liposomes. The prepared soft matter objects were studied by optical microscopy, transmission electron microscopy and dynamic light scattering technique. It is shown that optimal conditions for the production of magnetoliposomes using ferrofluids (γ-Fe_2O_3 NPs) and cationic 1,4-DHP **1** were obtained by positively charged γ-Fe_2O_3 nanoparticles using the SpSw method, with the following optimal conditions: 5 mg DHP **1**, 50µl of ferrofluid, temperature of swelling 45-50°C, process duration 20–30 min. It is shown that the REV method along with the use of 1,4-DHP 1 can be applied for the production of giant liposomes. By varying the 1,4-DHP **1** content, it is possible to control the size of liposomes.

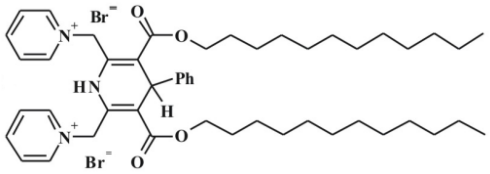

Fig.1. Structure of 1,1'-{[3,5-bis(dodecyloxy-carbonyl)-4-phenyl-1,4-dihydropyridin-2,6-diyl] dimethylen}bis-pyridinium dibromide (**1**)

ERAF EIROPAS REĢIONĀLĀS ATTĪSTĪBAS FONDS

The support from ERAF Nr.015/0008/2DP/2.1.1.2./14/APIA/VIAA/004; OSMOSE program No 22497YE and INNOVABALT projects is gratefully acknowledged.

References:

1. R.Massart et al. IEEE, **MAG-17**, 1247–1248 (1981)
2. Z.Hyvönen et al. Biochim. Biophys.Acta, **1509**, 451–466 (2000)
3. K.Pajuste et al. New J. Chem., 37, 3062–3075 (2013)
4. G.Beaune et al. J Phys Chem B, **112**, 7424–7429 (2008)
5. G.Beaune et al. Angew. Chem. Int. Ed, **46**, 5421–5424 (2007)