

## **PL: Magnetic Nanoparticles for Solving Diagnostics - Therapeutic problems with COVID-19**

A. Zelenakova<sup>1</sup>, V. Zelenak<sup>2</sup>, P. Hrubovcak<sup>1</sup>, J. Szucsova<sup>1</sup>, E. Benova<sup>2</sup>, L. Nagy<sup>1</sup>, M. Barutiak<sup>1</sup>, J. Kosuth<sup>3</sup>, Z. Sulinova<sup>4</sup>, S. Vilcek<sup>4</sup>

<sup>1</sup>*Department of Condensed Matter Physics, Pavol Jozef Šafárik University, Košice, SlovakiaCountry*

<sup>2</sup>*Department of Inorganic Chemistry, Pavol Jozef Šafárik University, Košice, Slovakia*

<sup>3</sup>*Institute of Biology and Ecology, P. J. Safarik University, Kosice, Slovakia*

<sup>4</sup>*Department of Epizootiology and Parasitology, University of Veterinary Medicine and Pharmacy, Komenského 73, 040 01 Kosice, Slovakia*

Last two years have shown us our limits in the fight with global pandemic. The spread of COVID19 disease revealed our vulnerability and inefficiency when dealing with a kind of serious virus in general. Despite of a large effort of scientific community, many crucial questions regarding corona virus

disease are still remaining unaddressed. The most important is concern a fast and plausible diagnostics and effective treatment. In response to these challenges, we have developed nanocomposite systems based on  $\text{Fe}_3\text{O}_4$  magnetic nanoparticles (NPs) for COVID19 diagnostics and therapeutic applications. Series of nanoparticle systems with magnetic core and amorphous silica ( $\text{SiO}_2$ ) shell have been prepared and their surface has been modified by specific organic ligands (Fig.1). Owing to the ligands, the prepared NPs are capable of bonding either virus RNA or anti-virus drug. By the action of applied magnetic field, the NPs may be concentrated in a certain point (diagnostics) or delivered into the affected tissue (treatment). Feasible magnetic performance of the prepared nanoparticle systems is therefore crucial for their application.

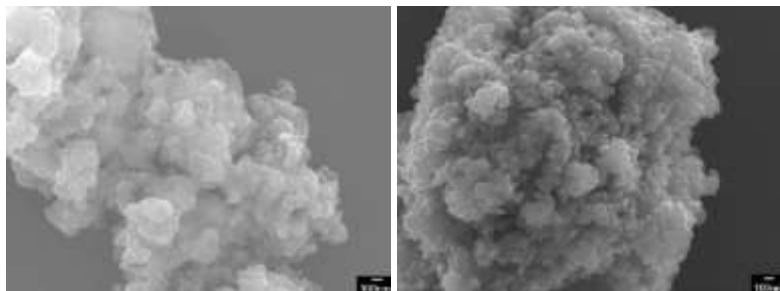


Fig.1. Structure of magnetic beads modified by organic ligands for RT-PCR diagnostics.

We have conducted series of magnetic measurements in order to distinguish between magnetic behavior of the pure nanoparticle system and systems with various coatings. We demonstrate the application of the fundamental models that have been modified in order to fit the experimental zero-field cooling magnetization data. We discuss the influence of the nanoparticle shell parameters (morphology, thickness,

ligands) on the overall magnetic performance of the systems. With the aid of magnetic data modeling along with the strong experimental support provided by other methods (electron microscopy, X-ray diffraction) we can conclude on nanoparticle structural and magnetic characteristics and the presence/absence of interparticle interactions. Accurate determination of nanoparticle system properties is essential for its further tuning towards the desired application.

Acknowledgments. This work was supported by the Operational Programme Integrated Infrastructure, project "NANOVIR", ITMS:313011AUW7, co-funded by ERDF and APVV-20-0512.

---