Silica coating on polymer drug delivery systems to improve their properties: stability, permeability and responsiveness.

Gleb B. Sukhorukov*[1], Hui Gao[1] and Alexander S. Timin[2],

[1] *School of Engineering and Materials Science, Queen Mary University of London, Mile End Road, London, E1 4NS, United Kingdom, E-Mail:g.sukhorukov@qmul.ac.uk*

[2] *Tomsk Polytechnic University, RASA centre, pros. Lenina, 30, Tomsk, Russia*

Polyelectrolyte multilayer capsules have raised the interest due to their high potential as delivery systems and application in biomedical research. Advantage of this technology is possibility for simple combination of different functions in one entity, meaning one can make the capsules carrying bioactive substances and in the same time can be sensitive to environmental factors such as temperature, pH and being addressable also by remote physical stimuli such as light, magnetic field and ultrasound [1]. However, the longstanding bottleneck of multilayer capsule application was the problem to keep small water soluble molecules in the capsules for sufficient time before it can be delivered and deployed. Recently this problem was solved by capsule coating of silica layer [2]. This layer of silica formed over polymers could make the capsules sealed enough to store various bioactive substances and in the same time the capsule become extremely sensitive to mechanical stress such as ultrasound. Thus, the capsules could carry small molecules and being very sensitive to ultrasound. Apart of that, silica coated capsules can be internalised by various cells and get degraded in cell interior over hours due to very thin shell. Obviously this process is followed by release of encapsulated materials [3]. So far the cell viability has not been affected by silica coated capsules. Silica coated capsules have been used also to deliver genetic materials into the cells that resulted their alternation without causing any toxicity effect [4].

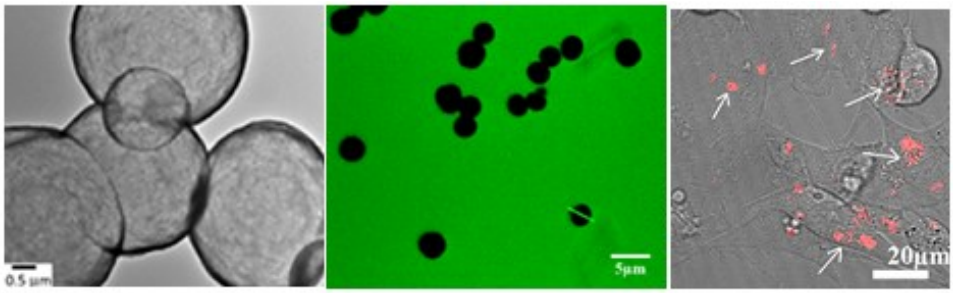

Figure 1. (from left to right) – TEM image of silica coated polyelectrolyte capsules, reduced permeability for fluorescein and silica coated capsules inside B50 cells

[1] M.N.Antipina, G.B.Sukhorukov. *Advanced Drug Delivery Reviews*, **2011**, 63, 716–729
[2] A.S.Timin et al. *Advanced Materials Interfaces*. **2017**, 4 (1), 1600338
[3] H.Gao et al. *ACS Applied Materials and Interfaces*, **2016,** 8 (15) 9651-9661
[4] A.S. Timin et al. Nanomedicine – Nanotechnology Biology and Medicine. **2018**, 14(1) 97-108