Novel Drug-Templated Mesoporous Silica Nanocontainers and Protocells Based Thereon

O.V. Dement'eva[1]
K.A. Naumova[2]
M.E. Kartseva[1]
V.M. Rudoy[1]

[1]Frumkin Institute of Physical Chemistry and Electrochemistry of RAS, 119071, 31 Leninsky Prospect, Moscow, Russia
[2]Department of Chemistry, Moscow State University, 119991, Moscow, Russia

dema_ol@mail.ru

Mesoporous silica nanoparticles (MSNs) are of significant interest as nanocontainers for different substances, primarily – for drugs [1]. Conventional route to use of such nanocontainers includes several stages: 1) sol-gel synthesis of MSNs using the micelles of "*inert*" surfactant as a template, 2) template removal, 3) modification of inner and/or outer surface of the MSNs (this allows one to control the sorption/desorption kinetics of a drug), 4) drug loading. This route results in low drug uptake and burst release that are insufficient for the most applications.

We propose a new approach that overcomes these drawbacks. This approach is based on the use of micelles (or vesicles) of the *targeted substance itself* (instead of *inert* surfactant ones) as templates at MSNs synthesis. As a result, it becomes possible to combine the stages of silica nanocontainers synthesis and their loading with the targeted substance.

The prospects and benefits of such route are exemplified by the encapsulation of various bactericidal drugs (including cleavable ones) and an antitumoral agent. It is shown that the synthesized nanocontainers are characterized by an extremely high capacity with respect to templating functional compound (about 1 g and over per 1 g of SiO_2) and are also pH-sensitive.

The effects of the template nature and conditions of the sol-gel process on the porous structure of silica vehicles are studied and discussed.

The kinetics of the template molecules' release from the silica nanocontainers is studied and some features of this process are analyzed.

We also discuss the possibility of such particles use as a basis to creation of protocells – fundamentally new means of drug delivery.

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References

[1] L.P. Singh, S.K. Bhattacharyya, R. Kumar, G. Mishra, U. Sharma, G. Singh and S. Ahalawat, Adv. Colloid Interface Sci., 214 (2014) 17.