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Diverse effect of PEO–PPO–PEO and PPO–PEO–PPO triblock copolymers on temperature responsive behavior of luminescent hard–soft colloids

Asiya Mustafina[a,*], Julia Elistratova[a], Lucia Zakharova[a], Yuliana Kudryashova[a], Olga Bochkova[a], Vladimir Burilov[b], Alexander Konovalov[a], Svetlana Soloveva[a]

[a] A.E. Arbuzov Institute of Organic and Physical Chemistry, Arbuzov street, 8, Kazan, Russia
[b] Kazan (Volga region) Federal University, Kremlevskaya str. 18, 420008, Kazan, Russia

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ABSTRACT

The present work introduces the interaction of hard and soft colloids in aqueous solutions at vari temperatures and concentrations, as well as at critical conditions of temperature induced phase s aration. Hard and soft colloids are represented by luminescent silica nanoparticles and aggregates PEO–PPO–PEO and PPO–PEO–PPO triblock copolymers correspondingly. The formation of the mix aggregates between hard and soft colloids in equilibrium conditions has been revealed by dynar light scattering measurements. The distribution of silica nanoparticles between aqueous and surf tant rich phases after phase separation highlights the effect of pH, architecture and concentration triblock copolymers on the mixed hard–soft colloids aggregation at cloud point conditions. The pecu aggregation and phase behavior of PPO–PEO–PPO pluronics should be assumed as the main reason of enhanced mixed aggregation with SNs at increased temperatures and concentrated conditions.

1. Introduction

The triblock copolymers, made up of poly(ethyleneoxide) (PEO) and poly(propyleneoxide) (PPO) blocks have been the subject of intense research over last two decades due to their unique solution behavior [1,2] and extensive industrial and biomedical applications [3–7]. The structural parameters of triblock copolymers are important variables influencing their colloidal properties [8–13]. Furthermore, the arrangement of the PPO and PEO blocks in the chain is the key factor affecting self-aggregation and phase behavior of these copolymers. Thus the comparative studies of PEO–PPO–PEO (pluronics or P-type triblock copolymers) and PPO–PEO–PPO (commonly known as reverse pluronics or R-type triblock copolymers) are well documented in literature [8–13]. The temperature induced aggregation and phase behavior of triblock copolymers in aqueous solutions have got great attention during recent decades due to their fundamental and practical importance [9–14]. The adsorption and aggregation of triblock copolymers onto hard colloids is a well known approach to improve many properties of the latter, including biocompatibility and colloidal stability [15–19]. Taking into account the diversity of colloidal properties of triblock copolymers with various architecture the modification of nanoparticles by pluronics as background-supporting colloid fluids provides a simple new concept of stimuli responsive separati recovery and redistribution of nanoparticles. The stimuli induc phase behavior plays a significant role in gaining colloidal stabil or separation of colloids [19–22], which in turn enables to isola purify and redisperse luminescent nanoparticles, such as qua tum dots, silica, gold or silver nanoparticles. Luminescent sil nanoparticles (SNs) represent well known type of colloids, wh have got wide application in bioanalysis and medicine [23–2 Thus the interaction between soft (triblock copolymers of vari architecture) and hard (silica nanoparticles) colloids is of great fu damental and practical importance. This interaction can modif hydrophilic–lipophilic balance of SNs, which in turn greatly affe their phase behavior. Taking into account that triblock copolym in aqueous solutions exhibit temperature induced aggregation a phase separation, their interaction with SNs should also be temp ature dependent. The interaction of SNs with triblock copolymers fluid colloids is a way to develop mixed colloids with temperatu dependent aggregation and phase behavior. Thus the interacti between luminescent SNs and triblock copolymers in aque solutions at equilibrium and critical conditions of phase separati is a goal of the present report. The interaction between soft a hard colloids at phase separation conditions will be analyz through the distribution of SNs between aqueous and surfacta rich phases after their temperature induced separation. The u of luminescent nanoparticles, where the luminescence ari from the Tb-complex doped into silica matrix, gives additio opportunities to reveal the distribution of nanoparticles betwe

* Corresponding author.
E-mail address: asiyamust@mail.ru (A. Mustafina).

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