



## Dynamic properties of $\beta$ -casein/surfactant adsorption layers

Boris A. Noskov<sup>a,\*</sup>, Olga Yu. Milyaeva<sup>a</sup>, Shi-Yow Lin<sup>b</sup>, Giuseppe Loglio<sup>c</sup>, Reinhard Miller<sup>d</sup>

<sup>a</sup> Department of Colloid Chemistry, St. Petersburg State University, Universitetsky pr. 26, 198504 St. Petersburg, Russia

<sup>b</sup> National Taiwan University of Science and Technology, Chemical Engineering Department, 43 Keelung Road, Section 4, Taipei 106, Taiwan

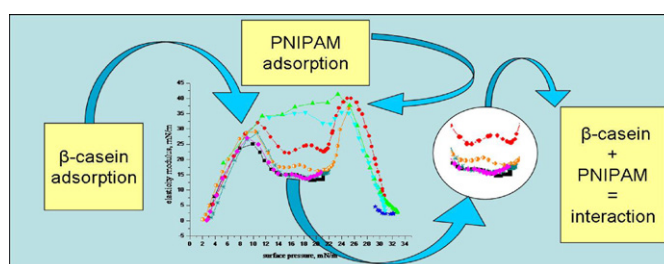
<sup>c</sup> Dipartimento di Chimica Organica, Università degli Studi di Firenze, Via della Lastruccia 13, 50019 Sesto Fiorentino, Firenze, Italy

<sup>d</sup> MPI für Kolloid- und Grenzflächenforschung, Wissenschaftspark Golm, D-14424 Golm, Germany

### HIGHLIGHTS

- ▶ The dynamic surface elasticity of mixed solutions of  $\beta$ -casein and surfactants was measured.
- ▶ The kinetic dependencies of the dynamic surface elasticity have a few local maxima.
- ▶ The height and position of the peaks give information on the protein displacement from the surface and protein–surfactant interactions.

### GRAPHICAL ABSTRACT



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### ABSTRACT

The dynamic surface elasticity of mixed solutions of  $\beta$ -casein and surfactants of different chemical nature was measured as a function of surface age and surfactant concentration with the aim to elucidate the influence of non-ionic interactions between the components on the dynamic surface properties. Small admixtures of the amphiphilic non-ionic polymer poly(*N*-isopropylacrylamide) (PNIPAM) did not influence the dynamic surface elasticity and the surface properties of the solution were entirely determined by the adsorbed protein. The corresponding kinetic dependencies of the dynamic surface elasticity have two local maxima. The increase of the polymer concentration resulted in the appearance of a third local maximum in the surface elasticity corresponding to the polymer adsorption. In this case the height and position of the second peak in the kinetic curve of the surface elasticity were changed noticeably indicating interactions between the components. The increase of the surfactant hydrophobic chain length in the case of small additions of cationic surfactants of low molecular weight increased the hydrophobicity of the formed protein/surfactant complex and also led to changes of the shape of the dynamic surface elasticity. The application of the scanning probe microscopy indicated different mechanisms of the  $\beta$ -casein displacement from the liquid surface by the surfactants of low and high molecular weights, correspondingly.

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## 1. Introduction

Different protein systems in nature or in industry are usually complex mixtures with properties determined by the interactions between the components. The formation of complexes

in aqueous solutions between proteins and surfactants of low molecular weight or between proteins and different polymers, mainly polysaccharides, has been intensively studied in recent years [1–3]. Although the surface properties of mixed solutions containing proteins are extremely important for various applied problems, for example, for the stabilization of foams and emulsions, any information on the influence of admixtures of different chemical nature on the protein conformation at the interface is rather scarce. Some attention has been paid recently only to the

\* Corresponding author. Tel.: +7 812 4284093; fax: +7 812 4286939.  
E-mail address: [borisanno@rambler.ru](mailto:borisanno@rambler.ru) (B.A. Noskov).