

Albumin Adsorption on the Surface of Iron Containing Aluminosilicates

V. Simon¹, S. Cavalu², M. Prinz³, E. Vanea¹, M. Neumann³, S. Simon¹

¹ Babes-Bolyai University, Faculty of Physics & Institute for Interdisciplinary Experimental Research, Cluj-Napoca, Romania. ² University of Oradea, Faculty of Medicine and Pharmacy, Oradea, Romania. ³ University of Osnabrück, Physics Department, Osnabrück, Germany

INTRODUCTION: Aluminosilicate materials present attractive properties for medical application as biomaterials [1]. Among the non-invasive protocols for cancer treatment, hyperthermia received renewed interests [2] and is considered a promising treatment for tumor eradication [3]. Biocompatible ferrimagnetic glass ceramics have been identified as suitable candidates for hysteresis heating [4,5]. The aluminosilicate glass ceramics optimised for hysteresis heating are highly stable in the body. Serum albumin is mainly responsible for the maintenance of blood pH and is associated to the binding and transport of several small molecules such as fatty acids, dyes, metals, amino acids, drugs, as well as several pharmaceutical compounds [6].

This paper reports on proteins uptake on the surface of iron containing aluminosilicate samples tested in simulated body fluids enriched with bovine serum albumin.

METHODS: Non-crystalline samples with $60\text{SiO}_2\cdot 20\text{Al}_2\text{O}_3\cdot 20\text{Fe}_2\text{O}_3$ composition obtained by sol-gel method were subjected to partial crystallisation by heat treatment in order to developed proper magnetic crystalline phases. After fine grinding the powder samples were immersed in simulated body fluid (SBF) prepared according to Kokubo composition and in SBF enriched with bovine serum albumin (BSA) in two concentrations obtained by adding 0.1 and 0.2 g lyophilised SBA to 30 ml SBF. The samples immersed were kept under static conditions at 37°C for up to seven days. Fourier transform infrared (FTIR) attenuated total reflectance (ATR) and X-ray photoemission spectroscopy (XPS) were used to inspect the albumin adsorption on the sample surface.

RESULTS: The IR results clearly evidence the presence of the protein only on the surface of the sample immersed for 7 days in the 0.67g BSA / 100 ml SBF solution. In the IR spectral region of amide I (1660 cm^{-1}) is recorded a new band at 1610 cm^{-1} which is assignable to intermolecular β -sheet structure (or side chains) and indicates the aggregation of the protein. The deconvoluted C 1s and N 1s photoelectron peaks provide more information. From the non-immersed sample only

one single C 1s peak at 285.5 eV is recorded. After one day immersion in SBF the C 1s photoelectron peak is still well fitted with a single line centered at 285.5 eV, but the peak is broadened (2.88 eV) with respect to the non-immersed sample (2.26 eV). The deconvolution of C 1s photoelectron peaks for the samples immersed in SBF solution enriched with BSA leads beside the peak at 285.5 eV to other two components centered at 286.7 and 288.6 eV, but their relative peak areas are notably different (Table 1). The occurrence of nitrogen species is evidenced only after SBF immersion.

Table 1. Percental distribution of differently binded carbons according to C 1s photoelectron peak deconvolution.

| BSA concentration in SBF (g/100 ml) | Binding energy (eV) | | |
|-------------------------------------|---------------------|-------|-------|
| | 285.5 | 286.7 | 288.6 |
| Relative peak areas (%) | | | |
| 0.33 | 82 | 13 | 7 |
| 0.67 | 51 | 42 | 5 |

DISCUSSION & CONCLUSIONS: X-ray photoelectron spectroscopy appears more sensitive than IR ATR spectroscopy to the changes occurred on the sample surface after immersion in simulated body fluids. The C 1s and N 1s core level XPS spectra show the BSA attachment to the surface of aluminosilicate samples already after one day immersion even in the low BSA enriched SBF.

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