World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:10, No:04, 2016

Tailorability of Poly(Aspartic Acid)/BSA Complex by Self-Assembling in Aqueous Solutions

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Abstract : Self-assembly processes are an attractive method to form new and complex structures between macromolecular compounds to be used for specific applications. In this context, intramolecular and intermolecular bonds play a key role during self-assembling processes in preparation of carrier systems of bioactive substances. Polyelectrolyte complexes (PECs) are formed through electrostatic interactions, and though they are significantly below of the covalent linkages in their strength, these complexes are sufficiently stable owing to the association processes. The relative ease way of PECs formation makes from them a versatile tool for preparation of various materials, with properties that can be tuned by adjusting several parameters, such as the chemical composition and structure of polyelectrolytes, pH and ionic strength of solutions, temperature and post-treatment procedures. For example, protein-polyelectrolyte complexes (PPCs) are playing an important role in various chemical and biological processes, such as protein separation, enzyme stabilization and polymer drug delivery systems. The present investigation is focused on evaluation of the PPC formation between a synthetic polypeptide (poly(aspartic acid) – PAS) and a natural protein (bovine serum albumin - BSA). The PPC obtained from PAS and BSA in different ratio was investigated by corroboration of various techniques of characterization as: spectroscopy, microscopy, thermo-gravimetric analysis, DLS and zeta potential determination, measurements which were performed in static and/or dynamic conditions. The static contact angle of the sample films was also determined in order to evaluate the changes brought upon surface free energy of the prepared PPCs in interdependence with the complexes composition. The evolution of hydrodynamic diameter and zeta potential of the PPC, recorded in situ, confirm changes of both co-partners conformation, a 1/1 ratio between protein and polyelectrolyte being benefit for the preparation of a stable PPC. Also, the study evidenced the dependence of PPC formation on the temperature of preparation. Thus, at low temperatures the PPC is formed with compact structure, small dimension and hydrodynamic diameter, close to those of BSA. The behavior at thermal treatment of the prepared PPCs is in agreement with the composition of the complexes. From the contact angle determination results the increase of the PPC films cohesion, which is higher than that of BSA films. Also, a higher hydrophobicity corresponds to the new PPC films denoting a good adhesion of the red blood cells onto the surface of PSA/BSA interpenetrated systems. The SEM investigation evidenced as well the specific internal structure of PPC concretized in phases with different size and shape in interdependence with the interpolymer mixture composition.

Keywords : polyelectrolyte – protein complex, bovine serum albumin, poly(aspartic acid), self-assembly
Conference Title : ICMSEM 2016 : International Conference on Materials Science, Engineering and Manufacturing
Conference Location : Paris, France
Conference Dates : April 25-26, 2016