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Interactions of calcium phosphate materials with therapeutic agents and biomedical applications

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Calcium phosphate (CaP) materials have received major attention in the biomedical field during the last decades, mainly for their compositional resemblance with the mineral phase of bone and their biological properties.Thus, numerousstudies have been devoted to develop biomaterials for bone replacement or repair as well as the use of these materials as carriers to deliver therapeutic agents in the skeletal systems. However, interaction mechanisms occurring at the interface between synthetic CaP and the surrounding environments are not totally elucidated. This work contributes to determine the in vitro basic binding and release profilesof biomimetic calcium phosphates nanoparticles and biological active molecules (anticancer drugs, bisphosphonates, antibiotics, proteins and aminoacids). The physicochemical parameters of the apatitic substrates (crystallinity, hydrated surface layer,chemical composition, microstructure, surface charge) as well asthe chemical properties of the solution (nature of the sorbent, concentration range, ionic composition, temperature) were taken as experimental variables to throw light on the main driving forces at the mineral surface. The adsorption results obtained indicated that, depending onthe conditions investigated, the shape of the isotherms is of Freundlich or Langmuir type. The binding of anionic molecules to the apatite surface affects the mineral ions contentin the solutionandwas accompanied by the release of phosphate ions.Conversely,the uptake ofthese sorbentswas inhibited in presence of excess active species (phosphate or carbonate), due to their competition for adsorbing sites on the apatite surface. A correlation between the loading capacity of the nanocrystals and the content of actives species in solution was established. Besides, the molecules bound to apatite crystals were not removed by simple dilution of the equilibrium solution, while desorption occur by changing different parameters (pH, ionic strength, concentration of potential determining ions); thus, the adsorbed molecules can only be displaced by a reverse action of phosphate ions and/or competitive adsorbing species. Adsorption from dilute solutions could be described as an ion-exchange process, involving the functional groups of the molecules and the ionic groups at the apatite surface. Whoever, the interaction appears to be reactive for concentrated solutions and the adsorption reaction could then be described as a dissolution-reprecipitation phenomenon. Adsorption on apatitic calcium phosphates may find several uses in biomaterials. Thus, the understandingof theadsorption and release processes could be exploited to associate therapeutic agents to the apatitic supports for drug delivery applications.

Biography

Allal Barroug is presently a professor at Cadi Ayyad University of Marrakech in Morocco, where he teaches since 1982. He received a Bachelor of chemistry (1979) from Mohamed V University of Rabat in Morocco, a Third Cycle Doctorate on materials science (1982) from the National Polytechnic Institute of Toulouse in France and a PhD (1989) on chemistry of interfaces from the Catholic University of Louvain-La-Neuve in Belgium. His awards from the Fulbright scholar program (three months during 1997 and 2004) and his grants from the Children's Hospital of Boston (October 97 to August98; June-August 1999) took him as a senior research scientist to the Harvard Medical School in USA to work on a project entitled "Apatite as a Local Delivery System for Anti-Cancer Drugs". His research interests focus on the preparation, characterization of calcium phosphate materials, the understanding of their surface reactivity toward biological molecules and the development of new biomaterials for drug delivery applications. His research activities include also the development of new solid materials (phosphates and clay minerals) in relation with natural resources valorization and water purification. He has supervised several doctoral theses and published over 60 articles in peer reviewed journals andconferences proceedings, and he is serving as a reviewer of several reputed journals.

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Study of localization of centers traps at the interface Si/SiO2

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In this paper we present the study of deep traps center, in the small area single electron photodetector (photo-SET or nanopixel). We perform the random telegraph signals (RTSs) measured in the dark conditions and under light illumination. From these results, we found that the traps centers are located in the oxide layer to the Si/SiOx=1.5 interface, that induces a carrier accumulation in the Si/SiOx=1.5 interface, and causes the formation of the electric field, where the conduction carriers could then be provided by the relay through nc-Si embedded in the oxide layer.

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