

Title: Smart Adaptation of Bone Tissue at the Nanoscale within Hierarchical Organization of the Skeleton

Dr. Sci. Andrey Pavlychev

Professor

St. Petersburg State University

RF

Abstract

The problems originated from skeletal pathology are of great socio-economic importance associated with medical treatment, rehabilitation and care of patients. Osteoarthritis is the fourth most common cause of hospitalization. Bone is the most complex hierarchically organized matter in nature. Two strongly interacting mineral and organic hierarchical organized subsystems extend from atoms to ecological spheres. At the nanoscale we encounter great difficulties in understanding because electronic and atomic structure and molecular architectonics of bone is not understood. This gap blocks successful solutions of many fundamental and clinically relevant problems such as the development of new methods of medical diagnosis of skeletal pathology at the early stage and innovational technologies in medical treatment of diseases associated with skeletal pathology. Our recent investigations have revealed that skeletal pathology produces various changes in nanostructure in intact and sclerotic areas of femoral bone in knee compartments. The strongest distortions are concentrated in the region where the mineral matrix interacts with the erased cartilage. Our efforts are aimed to find the ways of smart adaptation restoring the damaged bone nanostructure. The research of relationships between hierarchical organization of the skeleton and nanostructure of bone tissue is supported by the Russian Basic Research Foundation (19-02-00891)

Biography

Professor Andrey Pavlychev is researching the electronic and atomic structure and atomic dynamics in free molecules, clusters, encapsulated molecules and solids. Recently, his main interests have been focused on hierarchical nanostructures, in particular, on bone that is the most complicated matter in nature. Since 1996 Dr. Pavlychev is a professor at the St. Petersburg State University in the Solid States Electronics department. He lectures “Electronic structure of solids”, “Quantum chemistry of polyatomics”, “Nanophenomena in solids”. Professor Pavlychev has published more than 150 papers on Molecular and Cluster Physics, Condensed Matter, Hierarchical Nanostructures, Material Science, Medical Physics. Professor Pavlychev actively and successfully collaborates with research groups in Leipzig and Bonn Universities, Free University (Berlin), Tohoku University and Photon Factory in Japan and other scientific centers. He succeeded in studies of spatio-temporal localization of core-excited polyatomics, angular distributions of the photoelectrons in fixed-in-space molecules, nanolevel hierarchical organization of bone tissue and the hierarchy effects in electronic and atomic structure in bone. Since 2015, he successfully collaborates with Russian Research Institute of Orthopedics and Traumatology.