Alexander Shimkevich, J Material Sci Eng 2017, 6:7 (Suppl)
DOI: 10.4172/2169-0022-C1-080

Introduction in the band theory of liquid dielectrics

Alexander Shimkevich
NRC Kurchatov Institute, Russia

Though the band theory describes an electron population of energy bands on ideal crystal lattices, liquid dielectrics (pure water and molten salts) have the band structure too. It differs from bands in crystals by localization of electrons in "tails" of the allowed bands divided by a band gap. Just the band gap defines physical properties of dielectrics inasmuch as the allowed electronic levels near the bottom of conduction band (donors) and at the top of valence band (acceptors) change these properties. A position of such the impurity level in the band gap of liquid dielectric depends on its atomic concentration but its electron population depends on an electrochemical potential (Fermi level) in the band gap. This potential (as a p-n boundary between the vacant impurity levels and the ones occupied by electrons) becomes the management tool for physical and chemical properties of liquid dielectrics that is carried out by a "thin" shift of Fermi level in the band gap at the expense of an insignificant ($<10^{-5}$) deviation of the chemical compound composition from the stoichiometric one. This deviation is homogenized in any liquid medium. Controllable shifts of Fermi level in the band gap of ionic and molecular melts as variations of their oxidation-reduction potential (ORP) are theoretically studied including possibilities for managing their structural, physical and chemical, kinetic and corrosion properties. Correction of these properties by additives and selective extraction of fission products from the aqueous coolant and molten salts by shifting Fermi level are studied too.

Biography

Alexander Shimkevich has completed his PhD in 1982 from Institute for Physics and Power Engineering (IPPE), DS degree in 1998 from Institute for High Temperature of RAS, and full Professor in 2005. He has been employed by IPPE from 1971 to 2002 and by NRC Kurchatov Institute at present time. Prof. Shimkevich had over forty years of R&D experience in condensed matter physics for application to liquid metal technology and water chemistry of fast and thermal nuclear reactors. He has published more than 200 papers in reviewed journals and is serving as an editorial board member of "Atomic Eneger".

shimkevich_al@nrcki.ru

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