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Formation of new functional materials and device heterostructures on the basis of nanosystems of superionic conductors

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Search for conditions of conservation of fast ionic transport (FIT) in nanosystems of advanced superionic conductors (ASIC)[1-4] and synthesis of new types of device thin-film heterostructures on this basis is a fundamental scientific problem. ASICs (α-AgI, solid electrolytes of the family $RbAg_4I_5$, etc.) are crystals with a record high level of ionic conductivity and a low value of activation energy E~0.1 eV. The crystal structure of ASIC is close to optimal for FIT, however it is disturbed on arbitrary heteroboundaries. This leads to suppression of FIT in ASIC-nanosystems and considerable reduction in frequency-capacitance characteristics of ASIC//EC heterostructures (EC is an electronic conductor)-the basic functional elements of supercapacitors and solid electrolyte sensors.

The main topics of the work: (1) terms, approaches, classifications, concepts of new scientific discipline "Nanoionics and interface engineering of advanced superionic conductors" are offered and developed; (2) a new class of materials-ASICs among solid-state ionic conductors is distinguished; (3) existence of two classes of solid electrolyte nanosystems with FIT essentially differing in the character of boundary design are found; (4) the idea of creation of coherent interfaces ASIC//EC for FIT conservation in nanosystems is formulated and the algorithm of crystallochemical method of symmetry perfect ASIC//EC interface searching is developed; (5) conditions of Fermi level alignment on coherent heterojunctions for ASIC-nanosystems are formulated; (6) a new class of nanoionic supercapacitors is proposed and areas of their possible applications are suggested; (7) the new interface engineering approach "from advanced materials to advanced devices" is formulated.

References

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