



ABSTRACT BOOK

International research
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**NANOTECHNOLOGY
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26-28 of August 2026
Chernivtsi, UKRAINE

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AND NANOMATERIALS”**

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Abstract book

**Magnetic and magneto-optical studies of layered
diluted magnetic semiconductor
nanoparticles $\text{Pb}_{1-x}\text{TM}_x\text{I}_2$: (TM: Mn, Fe, Co)**

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Discovery of graphene's unique traits two decades ago [1] accelerated interest in layered structures. A key example is lead iodide (PbI_2), a highly anisotropic, wide-bandgap semiconductor ($E_g \approx 2.5$ eV) with high molecular weight and resistivity. Its crystal lattice features a repeating sandwiched structure: a hexagonally close-packed Pb^{2+} layer between two I- layers held together by weak van der Waals forces. Introducing transition metal dopants (Mn, Fe, Co) with unfilled 3d shells into PbI_2 single crystals yields layered diluted magnetic semiconductors (DMS). The fundamental properties of these systems are driven by the exchange interaction between the host matrix electrons and those in the partially filled d-levels of the magnetic impurities.

In this work we present results of experimental studies of the absorption spectra, photoluminescence and magneto-optical Faraday effect of colloidal solutions of PbI_2 : TM (TM: Mn, Fe, Co) nanoparticles as well as their based nanocomposites with polymer matrices as polyvinylalcohol (PVA) and gelatin.

The results of HR TEM and SEM studies indicate that the main feature of the obtained nanoscale structures is their plate-like shape with relatively arbitrary dimensions in the XOY plane and discrete thicknesses, multiples of one monoatomic I–Pb–I layer (0.7 nm). These results are in good agreement with the results of optical studies.

The angular and temperature dependence of EPR spectra suggests of strong spin exchange interactions due to presence of magnetic ions in the nanoparticles and demonstrates behaviors typical for ferromagnetic state.

Modeling of electrostatic and electron-deformation interaction of a semiconductor quantum dot–protein bionanocomplex with an antibiotic molecule

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Semiconductor quantum dots (QDs) are promising nanomaterials for biomedical applications due to their high photostability, spectral properties, and the possibility of functionalization with biomolecules. One approach to increasing the biocompatibility of QDs is the formation of bionanocomplexes with human serum albumin (HSA), which acts as a natural transport protein and is capable of binding a wide range of drugs. Of particular interest are complexes of the type (QD–HSA)–antibiotic, since local electrostatic interactions between the components of the system can significantly affect the stability of the complex and the electronic properties of QDs.

The work proposes a model of electrostatic and electron-deformation interaction in the QD–HSA–antibiotic system. The antibiotic molecule is considered as an effective localized charge that creates an electrostatic field near the HSA molecule. It is shown that the binding of the antibiotic leads to a redistribution of the electron density in the protein and a modification of the effective dipole moment of the complex.

Within the linear approximation, the change in the dipole moment of HSA is determined by the polarizability of the protein and the strength of the local electrostatic field of the antibiotic. The influence of the dielectric properties of the medium and the shielding of charges in the aqueous solution is taken into account.

The modified dipole moment of the complex forms an additional local electrostatic field near the QD surface, which can lead to polarization of charge carriers, changes in the energy of localized states, and the emergence of deformation effects in the near-surface region of the nanocrystal.

The results obtained are important for establishing the conditions governing the binding of an antibacterial drug to HSA. Such knowledge is especially important in cases of severe blood loss, where efficient transport and delivery of antibacterial drugs are required.