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HR EXCELLENCE IN RESEARCH

PHOTOSENSITIZERS FOR PHOTODYNAMIC AND PHOTOVOLTAIC THERAPY

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APPLICATION FIELD: Medicine, pharmacy, cosmetics, paramedical; Non-conventional energy sources

AIM: Photodynamic therapy (PDT) is a noninvasive treatment in medicine that utilizes photosensitizers (PSs) to produce highly cytotoxic reactive oxygen species (ROS) (e.g., $^{\bullet}O^{-}_{2}$, H_2O_2, -OH) to kill cancer cells. Dye photosensitizer is also key to photovoltaics. It requires not only a wide range of absorption of sunlight, combined with good absorption properties of materials, but also suitable oxidation–reduction potential, long lifetime of excited states, good photoluminescence, stability, ease of synthesis, and low cost. Tetrapyrrole structures such as porphyrins, chlorins, bacteriochlorins and phthalocyanines with appropriate functionalization have proved its properties as PSs for PDT and transporting materials in solar cells. Therefore, the development of a new photosensitizers based on self-assembly of functionalized metallphthalocyanines (MePc) with amino acids or conjugation to antibodies, peptides, proteins and other ligands with specific cellular receptors highly soluble in non-toxic water/organic solvents, absorption in the (700-800) nm spectral region and long lifetime of excited states is the aim of this project.

SOLUTION:

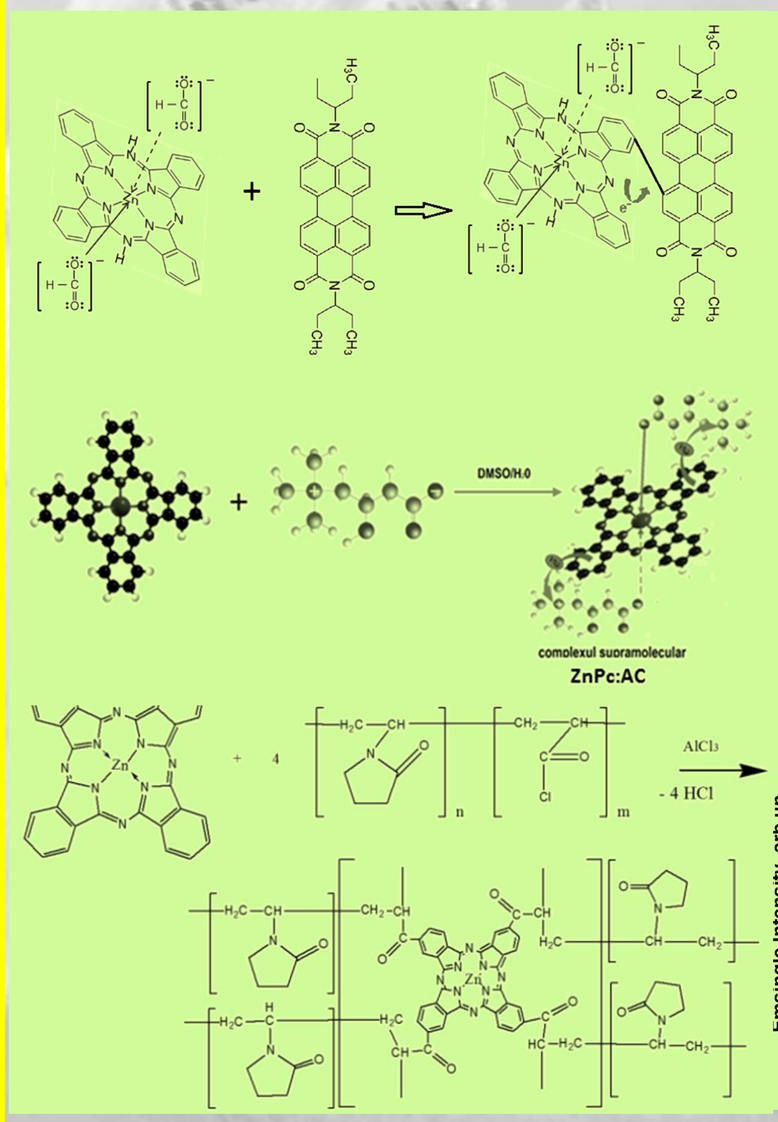
PHOTODYNAMIC THERAPY

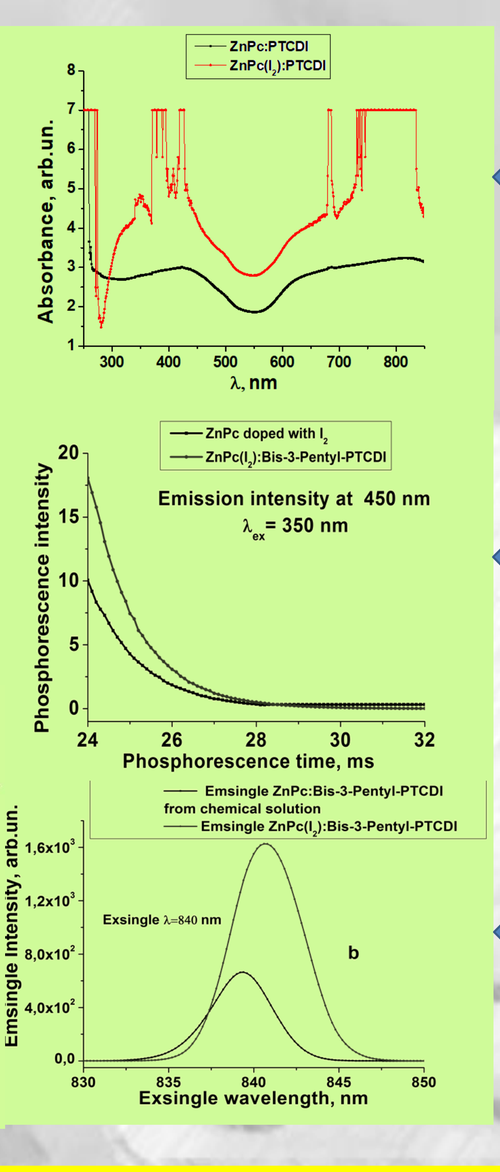
PDT is a highly multidisciplinary field that involves chemists, physicists, biologists, engineers and physicians. Chemists, of course, are constantly seeking to design, synthesize, purify and characterize new compounds that can be used as PSs. Many significant advances have been made in PSs design during the last 20 years, and second-, third- and even fourth-generation PSs have been described. Main NOVELTY of the project is development of PSs based on self-assembled of Zinc Phthalocyanine (ZnPc) and Bis-3-Pentyl - PTCDI derivative, ZnPc formulation with (3R)-3-hydroxy-4-(trimethylamino) butanoic acid and grafted ZnPc to binary copolymers N-vinylpyrrolidone (N-VP) with acryloyl chloride (Cl-AC).

PHOTOVOLTAICS

Recently, application of organic semiconductors in photovoltaic devices has acquired new impetus due to the growing interest in solar energy conversion. Organic semiconductors offer low material and fabrication costs with high power conversion efficiency that can possibly outcast existing inorganic solar-cell technologies. Metallphthalocyanines (MePcs) possess planarity, symmetry and electron delocalization that make them a perfect choice to be employed in solar cells. Another main NOVELTY of the project is the synthesis of ITO/PEDOT:PSS/ZnPc:I2/Al Schottky diode devices with open circuit voltage 1.03 V and bulk ZnPc:Bis-3-Pentyl-PTCDI heterojunction solar cells with efficiency of about 2.4%.

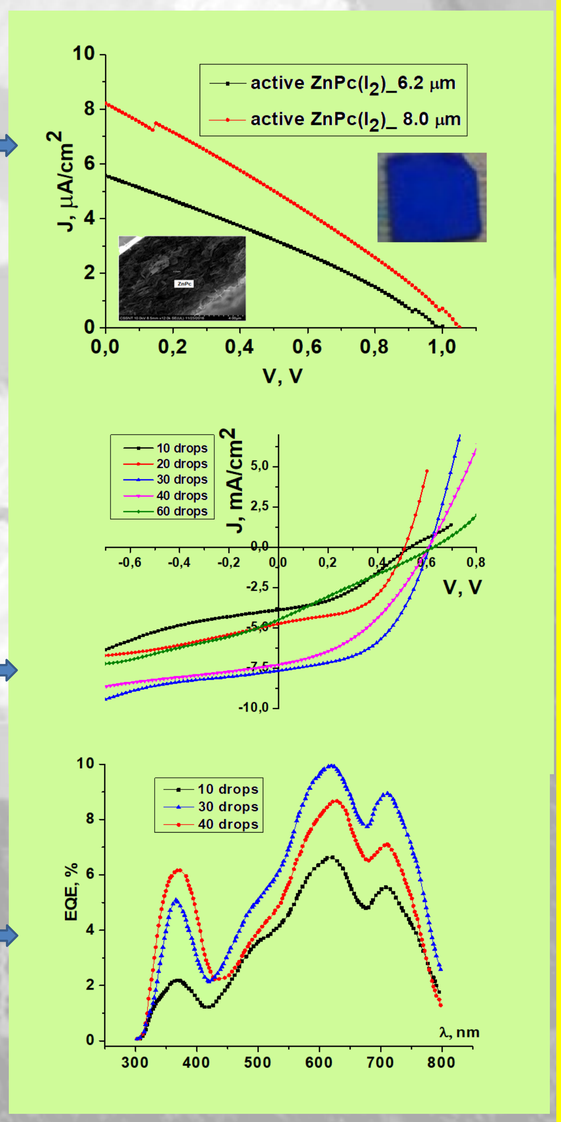
RESULTS OF KNOWLEDGE TRANSFER





ADVANTAGES:

- **Absorbance band in the (700-800 nm).**
- **The higher values of the open circuit voltage (1.03 V) and the current density (8.2 μA/cm^2) than in the case of Schottky diode devices obtained by thermal vacuum evaporation were reached.**
- **The phosphorescence lifetime values of the ZnPc and ZnPc:Bis-3-Pentyl-PTCDI system were found to be 2.4 ms and 1.1 ms, respectively.**
- **The best bulk ZnPc: PCDTI photovoltaic device reached an efficiency of about 2.4%**
- **The singlet oxygen generation abilities of PSs at 840 nm.**
- **External quantum efficiency is situated between 300 nm and 800 nm wavelengths.**



IMPLEMENTATION STAGE: Laboratory level.