With the rapid development of nanotechnology, design and synthesis of sophisticated nanomaterials have increased. Also, their exploitation in a variety of fields such as catalysis and environmental protection has drawn much attention. At the interface of these two fields, nanomaterials are used as photocatalysts allowing the degradation of various types of organic pollutants using UV-Vis light. Semiconductor nanomaterial often used like photocatalysts is TiO_2. As a result of light, electrons falling on its surface move from the valence shell to the conductivity band. Thanks to this, electrons are created on the surface of TiO_2, which combine with oxygen in the air to form active forms of oxygen and electron holes. These in turn, when combined with water vapor and water, form hydroxyl radicals. Depending on the conditions, holes (h +), OH, O^{2-}, H_2O_2 or O_2 radicals play the central role in the photocatalytic reaction mechanism. However, a significant obstacle to the use of TiO2 in photocatalysis is its ability to absorb only the world of ultraviolet, which significantly reduces its usefulness. In the last decade, the material that significantly contributed to the development of materials chemistry is polydopamine (PDA). It is a biocompatible polymer with strong adhesion and absorption properties in the UV, Vis and NIR range. The ability to absorb broad spectrum light through polydopamine has been used to increase the absorption capacity of TiO_2. Obtained composite TiO2-PDA type materials with PDA envelope <3 nm showing the relatively high efficiency of solar energy conversion for photodegradation of organic dyes in comparison with conventional photocatalysts in visible light. Furthermore, studies have shown that the photostability of PDA coated nanomaterials is higher than in the case of a pure semiconductor. However, the mechanism of the phenomenon causing such improvement of properties is still unknown. Therefore, research is needed to understand the effects of the nanoscale, which will allow the creation of advanced photocatalyst in the semiconductor system - polydopamine. In the project carried out in the OPUS competition, we intend to examine the electrical and optical changes of semiconductor nanocomposites (TiO2, Fe_3O_4, and ZnO) coated with polydopamine and its analogues, using advanced microscopic and analytical spectroscopic techniques. For this purpose we will use, among others from modern methods, electron microscopy with Spectroscopy Electron Spectroscopy (EELS) technology that provides exceptional spectroscopic abilities at the nanoscale, allowing the study of chemical composition, valence difference, 3D and 4D nanomaterials analysis and determination of dielectric material constant in the optical frequency range.