Abstract

This Ph.D. Thesis is based on publications to which the author contributed considerably. The list of the publications is attached at the end of this text.

This work describes preparation and photophysical properties of hybrid materials derived from layered double hydroxides (LDH) containing Zn^{2+}/Al^{3+} or Mg^{2+}/Al^{3+} cations. The materials were prepared in the form of powders or thin films. In the first part of my work, photosensitizing porphyrins have been intercalated into Zn_RAl and Mg_RAl LDH (R = 2, 3, 4) using anion-exchange, rehydration, and coprecipitation procedures. According to the obtained results of X-ray analysis, the orientation of the equatorial plain of the porphyrin molecules is nearly perpendicular to LDH layers and fosters the photosensitizing properties of the hybrid materials. Furthermore, the porphyrin-LDH hybrids were used as nanofillers and nanocontainers in eco-friendly polymers, polyurethane (PU) and poly(butylene succinate) (PBS). The porphyrin-LDH material is well dispersed in PU polymer (nanofiller function) to form transparent colored films while porphyrins remain intercalated between LDH layers (nanocontainer function). The polymers allow oxygen diffusion.

The second part has been dedicated to investigation of photophysical properties of the porphyrin-LDH powders and the porphyrin-LDH/polymer films. Upon irradiation with visible light, porphyrins embedded in the materials retain their photosensitizing properties with sufficiently long lifetimes of the triplet states to produce singlet oxygen ($^1O_2$). Singlet oxygen is known as a reactive species with cytotoxic effects. The porphyrin-LDH hybrid materials are suitable for the preparation of novel photoactive surfaces with controlled photoactivity of the porphyrin molecules anchored between the inorganic LDH layers. Such materials are readily suitable for construction of surfaces with photooxidative and bactericidal properties.