Photochemical properties of cobalt phthalocyanine pigment for the of solar cells

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Solar energy is the most attractive way to obtain environmentally friendly energy. As you know, during the process of obtaining energy from silicon-based solar panels, silicon molecules are doped with atoms of elements of the third and fifth groups and are divided into the process of forming p-n junctions. This process is very complex and requires a lot of energy, so the use of semiconductor pigments sensitive to sunlight can significantly increase the efficiency of this process [1].

Research is often carried out in the field of synthesizing metal phthalocyanines as sensitizing dyes in semiconductor pigment materials. In particular, cobalt phthalocyanine ($C_{32}H_{16}CoN_8$) [2] is a semiconductor pigment material that has been studied as a potential semiconductor dye pigment for electron charge evolution in the process of obtaining solar cells. The voltammetric properties of $C_{32}H_{16}CoN_8$ semiconductor sunlight-sensitizing dyes in dye-sensitized solar cells have been investigated in several studies. These studies showed that $C_{32}H_{16}CoN_8$ exhibits good photochemical activity in the electron charge evolution reaction (DSSC). The researchers attributed this activity to the high conductivity and good stability of the $C_{32}H_{16}CoN_8$ film.

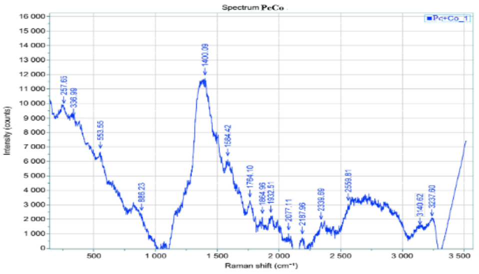

Fig.1 . Raman spectrum analysis of the PcCo pigment

In general, the electrocatalytic properties of PcMe semiconductor dye materials in solar cell production open up prospects for the development of efficient and stable anode materials by improving p and n junctions.

For the study of the photochemical properties a sensitive PcCo semiconductor pigment was synthesized by solid-phase deposition at high temperature in the presence of cobalt(II) sulfate, urea, phthalic anhydride, a catalyst, and concentrated sulfuric acid. The synthesized samples were deposited on a glass substrate with a size of 4×4 cm². The Raman spectrum analysis of the PcCo pigment is presented in Figure 1.

The following conclusions were drawn from the Raman spectroscopy analysis conducted to study the composition of the semiconductor pigment. The presence of an aromatic group in the benzene ring is determined by the absorption line at 3140.62 cm^{-1}. The valence vibration regions at 3237.60 cm^{-1} belong to O-H bonds. The valence and intensive vibration spectra are observed at 1864.96 cm^{-1} belong to C=O bonds, and the N-H bond spectra with differential vibrations are observed at 1584.42 cm^{-1}. The spectra in the 1400.09 cm^{-1} region belong to C-H bonds, and the differential bond spectra at 886.23 cm^{-1} belong to Me–N bonds. (EDX-8100 energy dispersive X-ray fluorescence spectrometer).

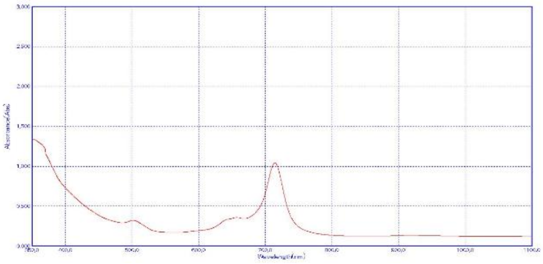

Fig.2 Optical absorption analysis of cobalt phthalocyanine pigment.

To study the photodynamic properties of cobalt-containing phthalocyanine dyes, it is necessary to analyze their spectral absorption characteristics. In particular, in the absorption spectrum of the cobalt phthalocyanine complex dissolved in N-methylpyrrolidone, a Q-band at 716 nm and B-bands in the range of 315–362 nm are observed. This makes them worthy of attention as a promising material for studying photovoltaic processes and for use in solar cells.

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