Synthesis of novel hybrid compounds consisting of carbon quantum dots, porphyrin and ZnO or N-doped TiO2 with photo induced biological activity

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**Abstract**

During this research were synthesized novel hybrid nanomaterials with photo-induced biological activity. The structure of these materials consists of three parts: (a) carbon quantum dots (CQDs), (b) a porphyrin and (c) a semiconductor. The semiconductor bound to the CQDs-porphyrin composite material is either titanium dioxide doped with nitrogen either zinc oxide. Carbon quantum dots were used in order to allow cell imaging, since they constitute a reasonably new kind of fluorescent material and were synthesized utilizing a simple one-step electrochemical method. Porphyrin is a heterocyclic macrocycle organic compound, which is used as a photosensitizer under visible light irradiation and was synthesized using the Lindsey method. N-doped titanium dioxide and zinc oxide nanoparticles were used for enhancing the photodynamic activity of porphyrin, due to their photocatalytic behavior and were synthesized through the sol-gel and precipitation method, respectively. The compounds were then thoroughly characterized by XRD, DLS, FE-SEM, TEM, XPS, UV-vis, FTIR and Raman spectroscopy. The biological effect of the novel nanomaterials was investigated on skin normal fibroblasts (CCD-1123Sk), skin/epidermis carcinoma (A-431) and skin malignant melanoma epithelial cells (SK-MEL-31).

KEYWORDS: Carbon quantum dots, porphyrin, zinc oxide, titanium dioxide, photodynamic therapy

REFERENCES

1. Amos-Tautua B. M., Songca S. P., Oluwafemi O. S. (2019). Application of Porphyrins in Antibacterial Photodynamic Therapy. Molecules (Basel, Switzerland), 24(13), 2456, 2019.
2. Gomes J., Lincho J., Domingues E., et al. (2019). N–TiO2 Photocatalysts: A Review of Their Characteristics and Capacity for Emerging Contaminants Removal, Water, 11, 373.
3. Bisht, G., Rayamajhi, S. (2016). ZnO Nanoparticles: A Promising Anticancer Agent. Nanobiomedicine, 3:9.
4. Liu, M., et al. (2016). Carbon quantum dots directly generated from electrochemical oxidation of graphite electrodes in alkaline alcohols and the applications for specific ferric ion detection and cell imaging. Analyst, 141, 2657-2664.