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Nanomachine based on carbon nanodots and iron oxide for efficient infrared therapy of breast cancer

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Nanocomposites made of iron oxide core, which is covalently capped with carbon nanodots have significant inhibitory effect on B16F10 cancer cells in the presence of near infrared irradiation (NIR). The reason is because the N-doped carbon nanodots (C-dots) can convert the lower energy NIR to higher energy blue light, which induce emission of electrons from the semiconductive Fe_2O_3 and generate reactive oxygen species. This process is known as up conversion photoluminescence and the subsequent photocatalytic oxidation was proved by bleaching of the organic dye rhodamine B. The inhibition effect of Fe_2O_3@C-dots was measured on the breast cancer cells B16F10 by in vitro scratch bioassay. In dark condition the nanomaterial exhibit minimal toxicity to the cells. However, by treatment with NIR irradiation in the range 700 ~ 800 nm the cancer cells were inhibited. The next step was to modify the nanocomposite Fe_2O_3@C-dots with oligonucleotide aptamers in order to achieve a structural recognition of cellular wall with followed higher specificity to cancer cells. Our experiments demonstrated that the normal cells are not object of inhibition, because they have enzymes to destroy such DNA nanomachines. Nevertheless, it remains toxic to the cancer cell which has lack of ability to protect from the nanomachines toxic effect. In conclusion, the photoactivatable iron oxide@Cdots–aptamer nanomachine may potentially be exploited in the photodynamic-related applications in the cancer therapy.

Biography

Alexandre Loukanov has completed his PhD from the Graduate University for Advanced Studies (SOKENDAI), Japan and DSc (Doctor of Sciences) from University for Mining and Geology, Sofia, Bulgaria. He is currently working as a Professor at Saitama University, Japan, invited Professor at Arkansas University for Medical Sciences, USA and Vice President of the European Nanoscience and Nanotechnology Association. He has published more than 60 research articles in the fields of Basic and Medical Nanotechnology.

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