

## **RADIOSENSITIZATION EFFECT OF BISMUTH-BASED NANOSHEETS UNDER PROTON BEAM IRRADIATION**

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Radiation therapy is used as the first line of therapy in more than 50% of patients with malignant tumors [1]. However, this therapeutic approach still has difficulties in effectively delivering the dose directly to the tumor growth zone. The transition to proton therapy of the tumor makes it possible to increase the accuracy of dose unloading, since the main proton energy is released in the biological tissue at the end of the particle trajectory ("Bragg peak") in accordance with the profile of the deep dose [2]. Despite the numerous known benefits of proton beam therapy, it has certain limitations of effectiveness due to the low therapeutic yield. One of the most promising methods of promoting proton therapy is associated with the use of nanotechnology approaches, which involve the use of nanoparticles as sensitizers for improved results caused by radiotherapy. Nanoparticles containing elements with high electron density (high Z element), such as bismuth, can act as such a radio sensitizer.

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In this study, we propose the use of PVP-stabilized bismuth nanosheets as a radiosensitizer to enhance the effectiveness of proton therapy. Bi nanosheets were synthesized through hydrolysis of bismuth chloride in an alkaline environment. Our results show that Bi nanosheets have a high degree of biocompatibility and strong radiosensitizing effects against breast carcinoma cells, especially when exposed to proton beam irradiation at the Bragg peak. After irradiation with proton beams, Bi nanosheets generate reactive oxygen species, which in combination with the proton irradiation significantly reduces the clonogenic activity of cancer cells, their cell cycle disruption and apoptosis. The maximum effect was observed at a dose of 3 Gy of irradiation and a concentration of 50  $\mu\text{g/mL}$  of Bi nanosheets. Given the high biocompatibility of this nanomaterial and the proton-induced radiosensitizing properties, we propose that the use of proton therapy in combination with Bi nanosheets technology could significantly improve cancer treatment.

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