

Surface Functionalization of Gold Nanorods with Peptides for Targeted Nuclear Delivery in Glioblastoma

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Functionalized gold nanorods (AuNRs) are gaining increasing attention in nanomedicine thanks to their unique physicochemical properties, which enable a broad spectrum of applications in both imaging and therapy. In the field of nuclear medicine, AuNRs labeled with the gamma-emitting isotope technetium-99m (Tc^{99m}) offer significant potential by coupling targeted radiation delivery with the emission of Auger electrons. These low-energy electrons exhibit an extremely short path length, making them particularly effective in inducing DNA damage when confined within the cell nucleus. Moreover, the interaction between gamma photons and gold can lead to the production of secondary Auger electrons, further amplifying therapeutic efficacy without elevating the radiation dose. Therefore, achieving precise nuclear localization of AuNRs is essential to fully exploit their therapeutic potential.

This study investigates the functionalization of AuNRs with the TAT peptide, a nuclear localization signal known to promote translocation into the nucleus of human glioblastoma T98G cells. AuNRs were synthesized with controlled dimensions ($39 \pm 5 \times 11 \pm 2$ nm, aspect ratio = 3.2) and low polydispersity, in agreement with established protocols. Subsequent functionalization was carried out by incubating the nanorods with optimized amounts of TAT peptide. Following extensive purification, successful peptide conjugation and surface modification were confirmed through UV-Vis, FT-IR, and XPS spectroscopy.

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