PEI/Cy5-functionalized Carbonated Apatite nanoparticles for efficient luminescent gene delivery

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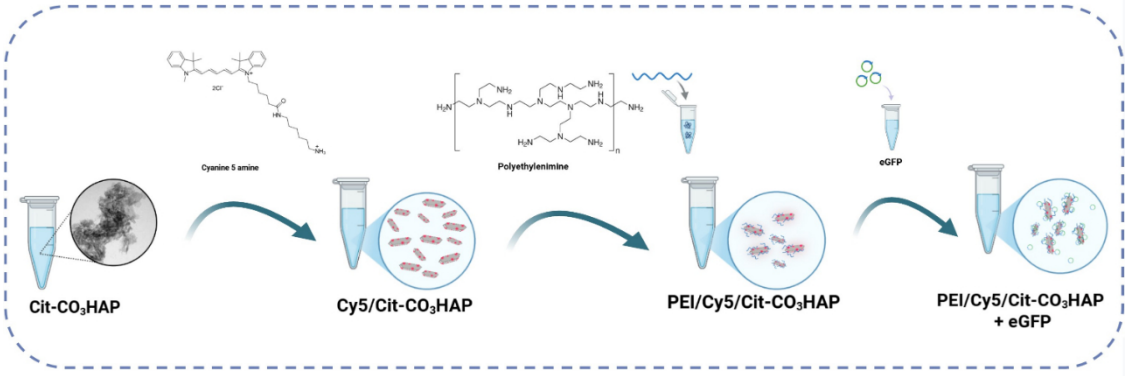
Among nanomaterials designed for directed delivery and controlled release of therapeutic biomolecules, hydroxyapatite-based nanoparticles (HAPs) have gained attention in nanomedicine due to their excellent biocompatibility, structural similarity to bone mineral, and ease of functionalization. Here, we have developed matured citrate-coated carbonated HAP nanoparticles (Cit-CO_3HAP), surface-functionalized with cyanine 5 (Cy5) and polyethyleneimine (PEI), as fluorescent gene delivery vectors both *in vitro* and *in vivo* . Plasmid DNA is loaded via isothermal adsorption onto the synthesized core–shell nanocarriers following the schema shown in figure **.**

The physico-chemical characterization of the nanosystem confirms its successful functionalization with Cy5 and PEI and the subsequent surface immobilization by physical adsorption of the negatively charged plasmid DNA (pDNA). The particle size based on the volume distribution for this functionalized nanosystem show a colloidal situation suitable for an adequate biodistribution in physiological fluids. Confocal microscopy experiments show an efficient cellular uptake and high transfection efficiency in breast and cervical cancer cell lines. Additional biocompatibility assays in cancerous and non-cancerous cells support the safety and versatility of these nanocarriers. The results highlight the broad potential of PEI/Cy5/Cit-CO_3HAP nanoparticles as safe, efficient, and multifunctional luminescent gene delivery vectors.

Keywords:
hydroxyapatite nanoparticles, citrate functionalization, polyethyleneimine (PEI), fluorescent gene delivery, nanomedicine applications



Process for the synthesis of functionalized PEI/Cy5/Cit-CO3HAP nanoparticles

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