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Polymeric nanosystems for near-infrared multispectral photoacoustic imaging: Synthesis, characterization and *in vivo* evaluation

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Abstract

Photoacoustic imaging (PAI) is a new biomedical imaging modality based on light-triggered ultrasound emission. For *in vivo* application, materials with good photoacustic response to illumination in the near-infrared spectrum and suited tissue delivery strategies are needed. We developed polymeric, near-infrared responsive nanomaterials tuned for *in vivo* application based on oxazoline block copolymer chemistry by living cationic polymerization and a related functional transformation, loaded with a new photonic material, hydrophobized phthalocyanine Zinc complex (H-PcZn), that was efficiently encapsulated into the nanoparticles by self-assembly. The resulting nanoparticles P-NPs and N-NPs bear positive, and negative surface charge, respectively. After physicochemical characterization, applicability of the two nanoparticles as photoacoustic contrast agents was evaluated *in vitro* and in phantom experiments, where they exhibited excellent PAI contrast. *In vivo* distribution and visualization of P-NPs and N-NPs following i.v. injection imaged by PAI was confirmed by cryosection fluorescence analysis and showed that the materials accumulated in tissues within 1 h with differential tissue distribution. This pilot study thus describes synthesis of a novel polymeric photoacoustic nanosystem and demonstrates its potential for multimodal, photoacoustic *in vivo* imaging and for fluorescence imaging.

Keywords

Amphiphilic copolymer; Nanoparticle; Photosensitizer; Photoacoustic agents; Biodistribution; Theranostic

Highlights

Two amphiphilic copolymers were synthesized by living cationic polymerization.

•A photonic material H-PcZn was prepared in combination of PDMS and PcZn.
•The H-PcZn was encapsulated in the two copolymers based nanosystems, respectively.
•Nanoparticles P-NPs and N-NPs exhibited powerful PA in phantom experiments.
•*In vivo* study confirmed the PA potentials of NPs and exhibited their distributions.