

## DOCTORAL THESIS

### Multi-functional upconversion nanoparticles for in vivo imaging, in vivo tumor suppression and photodynamic therapy

Chan, Chi Fai

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## ABSTRACT

Upconversion nanoparticles (UCNPs) have been utilized for biological applications. Unlike conventional linear excitation molecules, UCNPs are excited by 980nm and emit photon in visible and near infrared region. The unique photophysical property offers superior penetration depth and lower photo-cytotoxicity. With the aid of various vectors such as target-specific peptides and photosensitizers, the UCNPs can precisely interact selectively with designated proteins (Cyclin D1 and Polo-like Kinase 1) and cancer cells so as to achieve theranostic effect. This thesis illustrated the upconversion mechanism and anti-cancer effect by UCNPs conjugated with peptides. Two research studies focus on Cyclin D1 or Polo-like kinase 1 (Plk1) specific peptides coated UCNPs function as key cell cycle inhibitors, in vitro imaging agent and in vivo tumor suppressor. Apart from inorganic nanomaterials, graphitic phase carbon nitride (g-C<sub>3</sub>N<sub>4</sub>) nanoparticles coupled with porphyrin moieties act as cancer directional photodynamic therapy agents was also described in the aspects of detailed photophysical measurements and in vitro theranostic studies.

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