A New Biodegradable Photothermal Nanoagent for Cancer Treatment

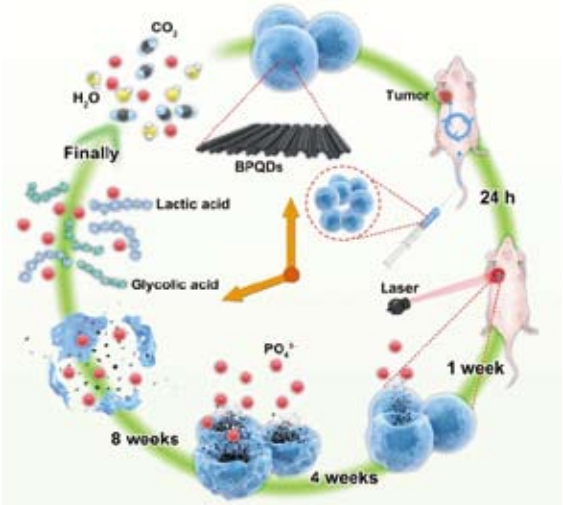
A research team from the Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences (SIAT) has prepared a novel biodegradable photothermal nanoagent based on black phosphorus. The work, led by YU Xufeng, ZHANG Han and Paul K. Chu, has been published by *Nature Communications*.

Development of novel nanomaterials and advanced nanotechnology for cancer treatment has attracted significant attention. As a promising alternative or supplement to the traditional cancer therapy, photothermal therapy (PTT) based on the interaction between tissues and near infrared (NIR) radiation offers many advantages including high efficiency and minimal invasiveness. But, the clinical adoption of PTT nanoagents has been stifled by the unresolved concerns such as the biodegradability and long-term toxicity.

Therefore, it is in dire need of developing new PTT agents which will have not only the proper size for efficient tumor targeting, but also the biocompatibility and biodegradability performance to ensure that the agent can be discharged harmlessly from the body in a reasonable period of time after completion of the designed therapeutic functions.

As a new member of 2D materials, atomically thin black phosphorus (BP) has shown many potential applications in electronics and optoelectronics. With phosphorus (P) as a vital element, BP can be degraded in aqueous media, and BP quantum dots (BPQDs) have not only large NIR extinction coefficient but also high photothermal conversion efficiency, as well as low cytotoxicity. All these properties lead to its potential therapeutic advantage. However, their actual clinical application in vivo still suffers from rapid renal excretion and degradation of the optical properties during circulation in the body.

To accomplish high therapeutic efficacy and desirable biodegradation, the researchers processed poly (lactic-co-glycolic acid) (PLGA) loaded with 3 nm BPQDs with an oil-in-water emulsion solvent evaporation method, and produced ~100 nm BPQDs/PLGA nanospheres (NSs). The hydrophobic PLGA not only isolated the interior BPQDs from oxygen and water to enhance the photothermal stability, but also controlled the degradation rate of the BPQDs in the physiological medium. The in vitro and in vivo experiments demonstrated that the BPQDs/PLGA nanospheres have inappreciable toxicity and good biocompatibility, possess excellent PTT efficiency and tumor targeting ability, which were evidenced by the highly efficient tumor ablation under NIR laser illumination.



Compared with other nanoagents, these BP-based nanospheres with their unique combination of biodegradability and biocompatibility are highly efficient PTT agents, and have immense clinical potential.

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