TBIS

Topic of the Speech:
Application of Supercritical Fluid Technology for Bio-imaging Guided Cancer Therapy

Professor Aizheng Chen
Huaqiao University
China

Professor Aizheng Chen received his Ph.D. degree in Biomedical Engineering from Sichuan University in 2007. After postdoctoral research at The Hong Kong Polytechnic University for two years, he joined Huaqiao University, where he is now a professor and vice dean of College of Chemical Engineering, and director of Institute of Biomaterials and Tissue Engineering. He also serves as a committee member of Chinese Society for Biomaterials, and the secretary-general of Chinese Society for Biomaterial-Composite Materials Branch. He was a visiting research professor for a year in Prof. Ali Khademhosseini Lab at Harvard medical school.

He has been granted 8 National projects, and has published more than 100 peer-reviewed publications; His research interests are the application of biomaterials for drug delivery systems using supercritical fluid technology, tissue engineering and regenerative medicine. He was listed in 2020 National Hundred, Thousand and Ten Thousand Talent Project and awarded with an honorary title "Young and mid-aged expert with outstanding contribution”.

ABSTRACT SUBMISSION
-FOR INVITED SPEAKER ONLY

TBIS

Application of Supercritical Fluid Technology for Bio-imaging Guided Cancer Therapy

Biao-Qi Chen, Ranjith Kumar Kankala, Pei-Yao Xu, Shi-Bin Wang, Ai-Zheng Chen*

Institute of Biomaterials and Tissue Engineering, Huaqiao University, Xiamen, 361021, China

*Presenter's email: azchen@hqu.edu.cn

ABSTRACT (NO MORE THAN 500 WORDS:)

The current trend in clinical research has gradually shifted from a focus on monotherapy to bio-imaging guided combinatorial therapy. In recent times, the supercritical fluid (SCF) technology has emerged as an effective alternative for operating various drugs alone or in combination with various biodegradable polymeric carriers in high-pressure conditions towards providing enhanced features with respect to their physical properties such as bioavailability enhancement, and stability improvement. In this vein, Indocyanine green (ICG), a near-infrared (NIR, >750 nm) fluorescence dye for biomedical imaging, diagnosis and photothermal therapeutics (PTT), still suffers from a few limitations such as poor aqueous stability, concentration-dependent aggregation *in vivo*, poor plasma half-life ($t_{1/2}$= ~3-4 min), prone to photobleaching and lack of target specificity. To overcome these aforementioned limitations, herein we fabricated versatile dual-triggered designs of ICG with high PTT efficacy and desirable biodegradation using various processes of the SCF technology. In a case, we demonstrate that the pH-responsive release of ICG from silk fibroin (SF) nanoparticles, specifically in the tumor acidic environment and its substantial activation with NIR light at 808 nm, significantly enhanced the PTT efficiency through hyperthermia. Moreover, ICG encapsulation in the SF nanoparticles through the single step, eco-friendly supercritical anti-solvent (SAS) approach has offered excellent photothermal stability. *In vitro* and *in vivo* photothermal experiments have shown that these ICG-SF NPs are highly capable of devastating tumor cells merely under light-induced hyperthermia. In another case, we fabricated ICG in its nanoparticulate forms using the SAS process and then coated with poly-$_{\mathrm{L}}$-Lysine (PLL) through electrostatic interactions for enhancing the stability of ICG in the aqueous environment. In addition, PLL coated over ICG has enhanced its stability to a great extent and also improved the cellular internalization efficiency of ICG. In an attempt to attain synergistic therapeutic benefits and address various intrinsic limitations of the highly efficient black phosphorus quantum dots (BPQDs), we fabricated poly(L-lactide)-poly(ethylene glycol)-poly($_{\mathrm{L}}$-lactide) triblock copolymer (PLLA-PEG-PLLA)-based nanocomposites co-loaded with BPQDs and gambogic acid (GA) using the SCF technology to achieve photoacoustic imaging-guided chemo-photothermal therapy. On the one hand, BPQDs displayed near-infrared (NIR)-induced hyperthermia through the high photothermal conversion efficiency. On the other hand, the NIR-responsive release of GA facilitated early apoptosis through specific binding to stress-induced overexpression of heat shock protein (HSP)-90 for combating thermo-resistant tumor cells. Moreover, the encapsulation of BPQDs in the co-block polymer significantly improved their chemical as well as photothermal stabilities. Together, our findings suggested that these nanocomposites fabricated using the environmental-friendly SCF technology provided excellent protection to these aqueous instability molecules, offering a great potential towards cancer ablation through augmented synergistic theranostics.