BIO Integration

Voice Series: Interview with Prof. Fuwu Zhang, University of Miami

Published Online: December 13 2022

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Foreword

Prof. Zhang is currently an Assistant Professor in the Department of Chemistry at the University of Miami. Prior to this appointment, Prof. Zhang was a postdoctoral fellow at the National Institutes of Health (advisor: Xiaoyuan Chen) and Texas A&M University (advisor: Karen Wooley). He received his Ph.D. in chemistry (advisor: Karen Wooley) from Texas A&M University in 2015. Research in his group is broadly includes organic chemistry, polymer chemistry, materials chemistry, chemical biology, drug delivery, and nanomedicine. The emphasis of Prof. Zhang's research, however, is focused on the translation of organic and polymer chemistry to functional nanomaterials designed for advanced disease treatment.

EE: Thank you Professor Zhang for being so gracious in accepting the invitation of *BIOI* for an interview. We understand that your background is in chemistry, but now you are venturing into many different applications, especially integrating chemistry and nanotechnology for medical applications. Can you tell us more about the current status of your research?

FZ: Chemistry is often described as the central science, providing insights and tools for many scientific fields. In my laboratory we exploit state-of-the-art chemistry to create functional and responsive nanomaterials for the safe delivery of therapeutics that range from small molecular drugs, peptides, and nucleic acids to proteins and targeted tissues for effective disease treatment with improved efficacy and reduced side effects. Our efforts rely on fundamental synthetic methodology development to afford unique molecular and macromolecular substrates, each designed with unique compositions, structures, and properties to exhibit function.

EE: Could you please share with us the breakthroughs in your laboratory over the years? What exciting news would you like to share with us?

FZ: Effective drug delivery to diseased sites has been challenging for many therapeutic agents. Many extremely cytotoxic drugs, such as monomethyl auristatin E (MMAE), have not been approved for cancer treatment due to unsatisfactory physicochemical properties and extremely high cytotoxicity. We have been working on prodrug engineering, in which these drugs are modified into smart prodrugs with tunable and responsive properties. For example, we designed a responsive glutathione-sensitive heterodimeric multifunctional prodrug, which displayed extremely high drug loading into common polymeric micelles and enabled direct drug monitoring by fluorescence imaging and positron emission tomography (*Angewandte Chemie International Edition* **2018**, *57*, 7066-7070). The high synergistic therapeutic efficacy of prodrug-loaded nanoparticles (NPs) highlights the advantage of our unique prodrug design, thus presenting exciting opportunities in polymeric NP-based drug delivery, as shown below in **Figure 1**.

EE: What was your major concern during the course of this research? Did you face major stumbling blocks along the way? If so, how did you overcome these problems?

FZ: One of the major concerns during our research is whether our uniquely designed smart nanomaterials can achieve their functions *in vivo* and ultimately in a clinical setting with favourable cost-effectiveness compared to existing treatments. It is always challenging to find the right chemistry to realize a specific function with good spatial and temporal control in nanomedicines.

EE: In reviewing your CV we understood that you have a pure chemistry background. When did you start transforming chemical studies into nanomedicine and other fields? Is the integration of these fields difficult?

FZ: I studied medicinal chemistry when I was an undergraduate student at Nankai University, where I studied the structural modification of parthenolide to increase its solubility and stability in the aqueous environment. My Ph.D. research was in chemistry with a focus on synthesizing polyphosphester-based degradable polymers and their applications in drug delivery. I became proficient in theranostic nanomedicine and translational research during my postdoctoral training with Professor Xiaoyuan Chen at

BIOI 2023, Vol 4, No. 2, 52–53
https://bio-integration.org doi: 10.15212/bioi-2022-0021

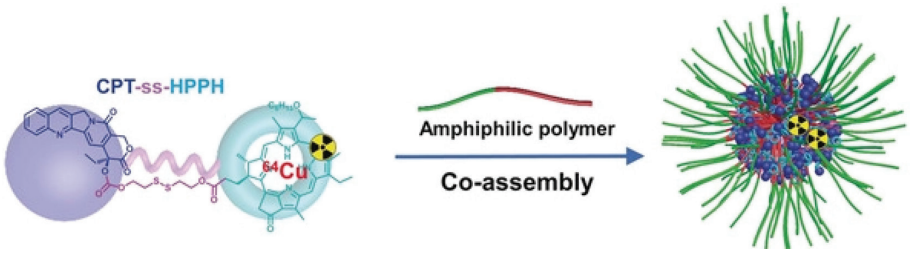

Figure 1 A two-in-one heterodimeric multifunctional prodrug (HDMP) was developed to have exceptionally high loading efficiency (97%) and capacity (59%) into polymer-based nanocarriers. The HDMP enables intrinsic radiolabeling and straightforward PET pharmacoimaging *in vivo*, and synergistic cancer therapy is realized. The figure is reproduced with permission from © 2018 Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim.

the NIH, which further strengthened my understanding and passion for nanomedicine. So, the integration of chemistry and medicine turned out to be a relatively natural process. Synthetic chemistry is the foundation for my career, while better medicine is the motivation that keeps me moving forward.

EE: What advice do you have for the young generation of scientists today?

FZ: I think it is equally important to develop a solid foundation in your field of study and have a broad knowledge across multiple fields. Broad knowledge gives us the ability to think creatively and apply what we learn to solve the puzzle. The integration of multiple scientific disciplines is essential for new breakthroughs.

EE: Do you have any advice for *BIO Integration* as an emerging journal?

FZ: In my opinion, *BIO Integration* is a great platform to learn the different perspectives of chemists, biologists, engineers, and clinicians. I have been following *BIO Integration* since 2020. The editorial team works for the journal enthusiastically and actively hosts workshops for young scientists and organizes stimulating seminars to exchange views and opinions from experts across the fields, which in my opinion is exceptional, should be continued, and is expected to significantly expand the Journal's readership and impact in the near future.

EE: Thank you Prof. Zhang. It was a pleasure to interview you.

FZ: Thank you.