



PhD Program between the Freie Universität Berlin (FUB) and the China Scholarship Council (CSC)

Open PhD Position at Freie Universität Berlin, offered only to Chinese CSC scholarship candidates 2019

Please Note: this PhD position is only offered to Chinese PhD candidates for the application in the framework of the FUB-CSC PhD Program.

<u>Department/Institute:</u>	Institute of Chemistry and Biochemistry
<u>Subject Area:</u>	Macromolecular Chemistry
<u>Name of Supervisor:</u>	Prof. Dr. Rainer Haag
<u>Number of Open PhD Positions:</u>	1
<u>Type of the PhD Study:</u>	Full-time
<u>Project Title:</u>	Responsive/Smart Nanoenzyme Architectures for Combating Drug-Resistant Bacteria

PhD Project description:

Currently, pathogenic bacterial infections have become the second largest cause of death with millions of victims all over the world every year. Furthermore, many of pathogens have developed drug resistance due to the abuse of antibiotics, which have now become more general causes of intractable infections in hospital. It has been reported that some types of nanomaterials, including Pt nanoparticles, V_2O_5 , MoS_2 , and carbon nanomaterials, have the peroxidase-mimic ability that can be used to efficiently catalyze the decomposition of H_2O_2 to generate $\cdot OH$ radical species for rapid bacterial disinfections. Thus, our research goal is to designing novel, smart, and biocompatible nanoenzymes that equipped with combined peroxidase-like catalytic activity and multiple antibacterial capabilities to fight drug-resistant bacteria in skin wound treatment. This project includes several parts: 1) designing environmental responsive nanoenzyme system with for rapid and safe bacterial disinfection, 2) constructing bacterial and inflammation tissue targeted nanoenzyme system via using neutrophil membranes for biointerface decoration, 3) in vivo tests for the antibacterial efficiency when combating drug-resistant bacteria, 4) animal tests in drug-resistant bacterial disinfection and skin wound healing treatment.

In detail, the candidate will analyze the nanomedicines, study the peroxidase-like catalytic activity and photothermal therapy, and reveal the interaction/inhibition/killing mechanism between bacteria and nanomaterials. The AFM, SEM, cryo-TEM, CLSM, XPS, XRD, Raman, NMR, electron paramagnetic resonance, and other needed instruments will be fully accessible in Device Center BioSupraMol and our institutes. To realize the in vitro and in vivo tests, we will also cooperate interdisciplinary with groups of Prof. Stephanie Reich (FU Berlin), Prof. Dr. Anna Gorbushina (BAM), Prof. Dr. Andreas Herrmann (HU Berlin), and also the Berlin-Brandenburg Centre for Regenerative Therapies (Charité, Berlin).

Language Requirements:

Fluent in English writing and speaking is required. PhD studies, thesis writing and defense in English is possible. IELTS 6.5 or TOEFL 95 ibt.

Academic Requirements:

We basically encourage graduates with a Master's degree in chemistry or polymer science, the solid research background and skills in designing nanomaterials for bacteria inhibition are required, and experience with animal experiments is recommended to apply for the PhD position in our group.

Information of the Professor or Research Group Leader:

Prof. Dr. Rainer Haag
Institut für Chemie und Biochemie - Organische und Makromolekulare Chemie
Freie Universität Berlin
Adresse: Takustr. 3 14195 Berlin
Website: www.polytree.de

Education

1992 - 1995 Ph.D. thesis at the Institute for Organic Chemistry, Georg-August-Universität Göttingen (Germany) with Prof. Dr. A. de Meijere
1996 - 1997 Postdoctoral fellow at the Chemical Laboratory, University of Cambridge (England) with Prof. Steven V. Ley
1997 - 1999 Research associate in the Department of Chemistry, Harvard University, Cambridge, Massachusetts (USA) with Prof. George M. Whitesides

Appointments

1999 - 2002 Assistant professor (Habilitation) at the Institute of Macromolecular Chemistry, Albert-Ludwigs Universität Freiburg (Mentor: Prof. Dr. Rolf Mülhaupt)
2003 - 2004 Associate professor of Organic Polymer Chemistry, University of Dortmund
Since 2004 Full professor of Organic and Macromolecular Chemistry, FU Berlin.
05-08/2009 Visiting professor, Harvard University, Cambridge (USA), with Prof. David Weitz

Honors and Awards

2014 Honorary Life Fellowship (Indian Society of Chemists and Biologists)
2010 Arthur K. Doolittle Award (American Chemical Society, PMSE Division), Steinhof Lecture Award 2010 (University of Freiburg)
2008 Director of the Collaborative Research Center SFB 765 on Multivalency (DFG)
2004 Nanoscience Award for Young Scientists from the Ministry of Science (BMBF)
2003 Dozentenstipendium of the German Chemical Industry (VCI)
2002 Heinz Maier-Leibnitz-Prize 2002 of the Deutsche Forschungsgemeinschaft (DFG)
2000 ADUC-Habilitanden-Award 2000 of the Gesellschaft Deutscher Chemiker (GdCh)
1997 Selected Member of the Studienstiftung des Deutschen Volkes

Selection of relevant publications

- 1 Z. Tu, H. Qiao, Y. Yan, G. Guday, W. Chen, M. Adeli, and R. Haag, *Angew. Chem. Int. Ed.*, 2018, 57, 11198. Directed Graphene-Based Nanoplatfoms for Hyperthermia-Overcoming Multiple Drug Resistance. DOI: 10.1002/anie.201804291
- 2 C. Cheng, S. Li, Y. Xia, L. Ma, C. Nie, C. Roth, A. Thomas, and R. Haag, *Adv. Mater.*, 2018, 1802669. Atomic Fe-Nx Coupled Open-Mesoporous Carbon Nanofibers for Efficient and Bio-Adaptable Oxygen Electrode in Mg-Air Batteries.
- 3 P. Dey, T. Bergmann, J. L. Cuellar Camacho, S. Ehrmann, M. S. Chowdhury, M. Zhang, I. Dahmani, R. Haag, and W. Azab, *ACS Nano*, 2018, 12(7), 6429-6442. Multivalent Flexible-Nanogels Exhibit Broad-Spectrum Antiviral Activity by Blocking Virus Entry.
- 4 Z. Tu, G. Guday, M. Adeli, and Rainer Haag, *Adv. Mater.*, 2018, 27(15), 160647. Multivalent Interactions between 2D Nanomaterials and Biointerfaces.
- 5 I. Donskyi, M. Drüke, K. Silberreis, D. Lauster, K. Ludwig, C. Kühne, W. Unger, C. Böttcher, A. Herrmann, J. Dervede, M. Adeli, and R. Haag, *Small*, 2018, 14(17), e1800189. Interactions of Fullerene-Polyglycerol Sulfates at Viral and Cellular Interfaces.
- 6 C. Cheng, J. Zhang, S. Li, Y. Xia, C. Nie, Z. Shi, J. L. Cuellar-Camacho, N. Ma, and R. Haag, *Adv. Mater.*, 2018, 30(5), 1705452. A Water-Processable and Bioactive Multivalent Graphene Nano-Ink for Highly Flexible Bio-Electronic Films and Nanofibers

- 7 S. Bhatia, D. Lauster, M. Bardua, K. Ludwig, S. Angioletti-Uberti, N. Popp, U. Hoffmann, F. Paulus, M. Budt, M. Stadtmüller, T. Wolff, A. Hamann, C. Böttcher, A. Herrmann, and R. Haag, *Biomaterials* 2017, 138, 22-34. Linear polysialoside outperforms dendritic analogs for inhibition of influenza virus infection in vitro and in vivo
- 8 A. Setaro, M. Adeli, M. Glaeske, D. Przyrembel, T. Bisswanger, G. Gordeev, F. Maschietto, A. Faghani, B. Paulus, M. Weinelt, R. Arenal, R. Haag, and S. Reich, *Nat. Commun.*, 2017, 8, 14281. Preserving π -conjugation in covalently functionalized carbon nanotubes for optoelectronic applications
- 9 C. Cheng, S. Li, A. Thomas, N. A. Kotov, and R. Haag, *Chem. Rev.*, 2017, 117 (3), 1826–1914. Functional Graphene Nanomaterials Based Architectures: Biointeractions, Fabrications, and Emerging Biological Applications
- 10 M. Fardin Gholami, D. Lauster, K. Ludwig, J. Storm, B. Ziem, N. Severin, C. Böttcher, J. P. Rabe, A. Herrmann, M. Adeli, R. Haag, *Adv. Funct. Mater.* 2017, 27 (15), 1606477. Functionalized Graphene as Extracellular Matrix Mimics: Toward Well-Defined 2D Nanomaterials for Multivalent Virus Interactions
- 11 Z. Tu, K. Achazi, A. Schulz, R. Mülhaupt, S. Thierbach, E. Rühl, M. Adeli, and R. Haag, *Adv. Funct. Mater.* 2017, 27 (33), 1701837. Combination of Surface Charge and Size Controls the Cellular Uptake of Functionalized Graphene Sheets
- 12 A. Faghani, I. S. Donskyi, M. F. Gholami, B. Ziem, A. Lippitz, W. E. S. Unger, C. Böttcher, J. P. Rabe, R. Haag and M. Adeli, *Angew. Chem. Int. Ed.*, 2017, 56 (10), 2675–2679. Controlled Covalent Functionalization of Thermally Reduced Graphene Oxide under Mild Conditions as Defined Bifunctional 2D Nanomaterials
- 13 A. Kumar, A. Khan, S. Malhotra, R. Mosurkal, A. Dhawan, M. Pandey, R. Kumar, A. Prasad, S. Sharma, L. Samuelson, A. Cholli, C. Len, J. Kumar, A. C. Watterson, V. Parmar, B. Singh, and R. Haag, *Chem. Soc. Rev.*, 2016, 45, 6855-6887. Synthesis of Macromolecular Systems via Lipase Catalyzed Biocatalytic Reactions: Applications and Future Perspectives
- 14 S. Bhatia, J. L. Cuellar Camacho and R. Haag, *J. Am. Chem. Soc.*, 2016, 138 (28), 8654–8666. Pathogen Inhibition by Multivalent Ligand Architectures
- 15 B. Thota, L. H. Uner, and R. Haag, *Chem. Rev.* 2016, 116, 2079–2102. Supramolecular Architectures of Dendritic Amphiphiles in Water
- 16 Z. Qi, P. Bharate, C.-H. Lai, B. Ziem, C. Böttcher, A. Schulz, F. Beckert, B. Hatting, R. Mülhaupt, P. H. Seeberger and R. Haag, *Nano Lett.*, 2015, 15, 6051–6057. Multivalency at Interfaces: Supramolecular Carbohydrate-Functionalized Graphene Derivatives for Bacterial Capture, Release, and Disinfection
- 17 Q. Wei, K. Achazi, H. Liebe, A. Schulz, P.-L. M. Noeske, I. Grunwald, and R. Haag, *Angew. Chem. Int. Ed.*, 2014, 53, 11650–11655. Mussel-inspired dendritic polymers as universal multifunctional coatings
- 18 Q. Wei, T. Becherer, P.-L. M. Noeske, I. Grunwald, R. Haag, *Adv. Mater.* 2014, 26, 2688–2693. A universal approach to crosslinked hierarchical polymer multilayers as stable and highly efficient antifouling coatings
- 19 D. Steinhilber, T. Rossow, S. Wedepohl, F. Paulus, S. Seiffert, R. Haag, *Angew. Chem. Int. Ed.* 2013, 52, 13538-13543, A Microgel Construction Kit for Bioorthogonal Encapsulation and pH-Controlled Release of Living Cells

Please Note: In a first step, the complete application should be submitted to the Beijing Office for evaluation by January 4th, 2019. Please do not contact the professor before. He/she will get in contact with you after having received the complete application via the Beijing Office in January.