



## 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.*

<b><u>Department/Institute:</u></b>	Department of Biology, Chemistry, Pharmacy / Institute of Pharmacy
<b><u>Subject Area:</u></b>	Polymer- and Colloidal Chemistry
<b><u>Name of Supervisor:</u></b>	Prof. Dr. Daniel Klinger
<b><u>Number of Open PhD Positions:</u></b>	1
<b><u>Type of the PhD Study:</u></b>	Full-time
<b><u>Project Title:</u></b>	Development of Functional Nanomaterials by Controlling Shape and Morphology of (Block) Copolymer Nanoparticles

#### **PhD Project Description:**

From molecules to bio-inspired materials – Nature has the outstanding ability to create specific macroscopic functions by controlling shape and internal morphology of particle-based systems. In such a hierarchical approach, anisotropic compartments are combined with the precise spatial distribution of chemical functionalities. This accurate structural control leads to complex dynamic properties that are yet unmet in synthetic approaches.

In the Klinger group, we are striving for similar levels of control in new artificial nanoparticles with anisotropic shapes and complex internal morphologies. It is our aim to harness the power of such multifunctional nanoparticles in advanced applications ranging from nanopharmaceuticals to photonic materials.

To participate in our quest to such nature-inspired materials, the candidate should impart new functionality into striped ellipsoidal block copolymer nanoparticles. Special emphasis of the project will be exploiting their reversible anisotropic shape change. This will enable their utilization as new targeting concept in pharmaceutical applications or as new building blocks for smart actuating materials, i.e. artificial muscles.

To successfully realize this project, concepts from synthetic macromolecular chemistry should be combined with methods from the fields of colloidal chemistry and block copolymer phase-separation. Thus, this multidisciplinary project includes synthesis and characterization of the respective (macro-) molecular building blocks, their assembly into nanoparticles, characterization of the colloidal materials, and investigations on the resulting macroscopic functionality.

#### **Language Requirements:**

IELTS: 6,5 / TOEFL: 95 ibt  
Excellent English language skills required

**Academic Requirements:**

- Completed university degree (Master) in chemistry, materials science, pharmacy or closely related fields
- Sound knowledge and practical expertise in organic chemistry / polymer chemistry / colloidal chemistry

**Information of the Professor or Research Group Leader:**

In the Klinger Lab, we focus on the development of nano-structured polymeric materials and colloids with dynamic and responsive properties. Our research is inspired by nature's outstanding ability to create very specific (macroscopic) functions through molecular and structural design. To approach similar levels of control in synthetic materials, we work on multiple length scales: Starting from the rational design of molecular units, we develop well-defined polymeric architectures and control their self-assembly into ordered superstructures. Additionally, we focus on the use of confinements to create additional elements of hierarchy. The synergy between chemical and structural functionality allows the development of polymeric nanoparticles and -materials for a broad variety of applications:

On one hand, we are precisely tailoring the properties of stimuli-responsive nanocarriers to specific controlled release applications, i.e. we are using concepts from polymer chemistry and colloidal synthesis to tackle current challenges in pharmaceutical research efficiently. Of special interest is the development of new stimuli-responsive amphiphilic nanogels with adaptive properties to address the challenging delivery of drugs into the skin as tight biological barrier. In addition, I am focusing on the development of smart polymeric nanocarriers to increase the potential of antibiotics of last resort. By identifying molecular triggers from resistant bacteria and translating these into new response mechanisms in polymeric carriers, I am bringing together concepts from molecular biology, polymer chemistry and colloidal synthesis to address one of the main threats to human health.

On the other hand, we are working on the development of new strategies to control shape and morphology of polymeric nanoparticles to realize advanced materials such as colloidal Bragg stacks, shape changing materials for targeting and artificial muscles. The development of such materials requires the combination of concepts from polymer chemistry with interfacial physics and self-assembly to create versatile dispersed colloids with novel properties.

Additional information can be found on our website:

<http://www.klinger-lab.de/>

**Please Note:** In a first step, the complete application should be submitted to the Beijing Office for evaluation by January 4<sup>th</sup>, 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.