UNNC – SIMM, CAS Doctoral Training Partnership

Available PhD topics

Formal applications should follow the instructions in 'How to apply' section.

PhD topic 1	**Design and application of graphene coupled antibody detection kit**
SIMM Supervisor	Prof Chunhe Wang
UNNC Supervisor(s)	Prof Cheng Heng PANG
Short introduction & description of PhD project	Graphene has very bright prospects in biomedicine and drug delivery. Graphene's unique two-dimensional structure makes it have bright application prospects in the field of sensing and detection. Its large surface area makes it very sensitive to the surrounding environment, which shows that graphene has high detection sensitivity. Antibody, also known as immunoglobulin, is a large Y-shaped protein mainly secreted by plasma cells and used by the immune system to identify and neutralize foreign substances such as bacteria, viruses and other pathogens. An antibody can uniquely recognize a specific foreign object through its variable region, which is called an antigen. When the antibody is coupled with graphene, the detection kit can be made according to the targeting of antibody and the ultra-high sensitivity of graphene, which has great prospect and research value.
Contact points	Informal inquiries may be addressed to Prof Cheng Heng PANG (ChengHeng.Pang@nottingham.edu.cn) and Prof Chunhe Wang (wangc@simm.ac.cn).
PhD topic 2	**Discovery and biosynthesis of antibiofilm peptides**
SIMM Supervisor	Baofu Xu
UNNC Supervisor(s)	Enrico Marsili
Short introduction & description of PhD project	Antimicrobial resistance has been causing tremendous concern in public healthcare. In addition to the overuse of antibiotics, biofilm also enhances the resistance of pathogens to commonly used antibacterial agents. Biofilm-based infections are associated with 80% of microbial infections. However, no commercial

	antimicrobial drugs targeting biofilm have been developed, probably due to the lack of high efficient biofilm testing platform. At University of Nottingham Ningbo China (UNNC), assoc. Prof. Enrico Marsili has pioneered the bioelectrochemical characterization of biofilms and testing of antimicrobial and antibiofilm agents. These methods allow cost-effective and real-time testing under realistic conditions, both on the standard surface and biomedical devices by developing techniques for biofilm analysis with bioelectrochemical instruments. With the well-developed and easy-to-use biofilm testing platform in hand, the candidate student will efficiently evaluate the antibiofilm activities of designated agents, easing the process of discovering new antibiofilm agents. Prof Baofu Xu works at the Shanghai Institute of Materia Medica, Chinese Academy of Sciences (SIMM, CAS), where established with state-of-the-art facilities and core technology platforms. Prof Xu's current work is focusing on discovery and biosynthesis of bioactive natural products from marine resources. This project, funded by both supervisors, focuses on discovering active peptides with similar antibiofilm characteristics to LL-37 or AS10 and on building an efficient biosynthesis platform producing the targeted peptides. The candidate student will work with two supervisors (B.X. and E.M.) to identify new peptides or toxin-like proteins from marine organisms, such as sea cucumber, Asteroidea, marine fungi, and marine bacteria, perform biosynthesis-related experiments, and evaluate the antimicrobial and antibiofilm activities. A pre-clinical trial could also be envisioned if the project goes very smoothly.
Contact points	Informal inquiries may be addressed to Assoc Prof Enrico Marsili (enrico.marsili@nottingham.edu.cn) and Prof. Baofu Xu (bfxu@simm.ac.cn)
PhD topic 3	**Discovery of new marine-derived antibiofilm agents**
SIMM Supervisor	Baofu Xu
UNNC Supervisor	Enrico Marsili
Short introduction & description of PhD project	The quest for novel antimicrobial compounds primarily relies on the bioprospecting of terrestrial and marine organisms capable of producing potent antimicrobials with low cytotoxicity. When these putative antimicrobial agents are screened for their activities, the screening is carried out mostly on planktonic cells in microwell plates. However, planktonic cells are rarely encountered in real-world conditions (e.g., clinical settings), where biofilm is the dominant mode of life for pathogens. Biofilms are microstructured communities of microorganisms living at solid interfaces. In biofilms, microorganisms are encased in a microbially-produced extracellular polymeric matrix composed on carbohydrates, protein, and extracellular DNA. The biofilm matrix provides a mechanical and chemical barrier to antimicrobial compounds, which must penetrate the matrix before reaching the viable cells and exerting their antimicrobial effect. Biofilms are responsible for approximately 60% of all infections and 80% of the chronic infections.

	The minimum inhibitory concentration for antimicrobials is much higher (10-100 times) in the presence of biofilms than with planktonic cells, thus the conventional antimicrobial screening might not provide reliable results. While biofilm testing is highly desirable, there are technical difficulties associated with growth and maintenance of reproducible biofilms. Enrico Marsili has developed an easy-to-use biofilm testing platform based on bioelectrochemical analysis, which can be used on single species and polymicrobial biofilms, the most relevant for clinical applications. The platform allows the characterization of both lethal and non-lethal (e.g., biofilm dispersing) antibiofilm agents. In this project, the student will work with both supervisors to isolate novel compounds from marine fungi or bacteria, perform biosynthesis-related experiments, and characterize the antimicrobial and antibiofilm activity of the newly isolated compounds using bioelectrochemical methods. If the lab-scale characterization is successful, the opportunity for pre-clinical trials in collaboration with a local research hospital might be considered. Both supervisors will fund the research expenses for this project. The Ph.D. candidate will have access to high-end equipment and receive excellent training, which will help in securing a position in the Antimicrobial Agents industry at the end of the Ph.D. or engage in an academic career. The prospective supervisors have 20 years of combined research experience in antimicrobial compounds, and they have supervised to completion 6 Ph.D. students. Shanghai Institute of Materia Medica, Chinese Academy of Sciences (SIMM, CAS) was founded in 1932, focusing on drug discovery and development against cancer, cardio-cerebrovascular disease, neuropsychiatric disease, metabolic disease, autoimmune disease, infectious disease, etc. Over 100 new drugs have been developed thus far. SIMM-CAS has been established with state-of-the-art facilities and core technology platforms. The University of Nottingham Ningbo is the first Sino-foreign University in China and comprises both international and Chinese scholars with strong research experience. China Beacons Institute is a newly opened research centre focused on ecological transition and sustainable technology.
Contact points	Informal inquiries may be addressed to Assoc Prof Enrico Marsili (enrico.marsili@nottingham.edu.cn) and Prof. Baofu Xu (bfxu@simm.ac.cn)
PhD topic 4	**Novel drug delivery system for encapsulating multiple components using microfluidics**
SIMM Supervisor	Prof. Yongzhuo Huang
UNNC Supervisor(s)	Dr Yong Ren
Short introduction & description of PhD	This project will aim to develop a facile microfluidic technology to synthesize highly monodispersed microcapsules with multi-cores, the microcapsules will be incorporated with certain functional groups, and the core/shell structured

	microcapsules can be applied as highly functional carriers with notable advantages for co-encapsulation of diverse incompatible ingredients without cross-contamination, and this will significantly enhance the loading capacity. The intrinsic good size monodispersity of microcapsules will enable exquisite control over drug release kinetics. The capsules can lead to broader biomedical applications including cancer therapy and new route of drug delivery for nuclear acids, proteins, vaccines, as well as multiple components with contrasting pH values. There are over 70% new chemical entities having water solubility problem, and many also have stability issue. These low solubility and stability problems often cause formidable challenge for further development and lead to poor drugability. The microfluidics-based drug encapsulation technologies can provide a useful solution to the issues by incorporating active compounds with various properties. The encapsulated drugs not only benefit from the physical protection against the unwanted degradation and premature release, but also are able to regulate their biodistribution and achieve enhanced accumulation in the pathological sites.
Contact points	Informal inquiries may be addressed to Prof. Yongzhuo Huang (yzhuang@mail.shcnc.ac.cn) and Dr Yong Ren (yong.ren@nottingham.edu.cn).
PhD topic 5	**Single cell glycan analysis combined with droplet microfluidics**
SIMM Supervisor	Prof Wei Huang
UNNC Supervisor	Prof Weihua Meng
Short introduction & description of PhD project	Glycosylation is a carbohydrate-based post-translational modification associated with the regulation of multiple cellular processes in different cell types and species, such as cell proliferation, differentiation, migration, signal transduction, and immune homeostasis. It makes great sense to develop and establish a method to analyze cell surface glycans directly on a single cell. Different methods have been utilized to analyze glycans, such as MS, HPLC, NMR, and CE. However, these methods still remain great challenges at a single-cell level. The droplet microfluidic system is a good strategy for single-cell analysis. Monodisperse aqueous droplets flow in an inert carrier oil in microfluidic channels on a chip and each droplet functions as an independent microreactor. Two groups of barcodes are designed, one for carbohydrate-binding lectins, and another for beads. One droplet contains a single cell, conjugated with a glycan-lectin-barcode complex, and a bead linked with another unique barcode. An oligonucleotide chain is generated with two barcodes from lectin and bead respectively. Computational and bioinformatic tools will be employed for data process. The major goal of this project is to profile the distinct glycans at single-cell level and to elucidate the role of glycan in stem cell differentiation.
Contact points	Informal inquiries may be addressed to Prof Weihua Meng (Weihua.Meng@nottingham.edu.cn) and Prof Wei Huang (huangwei@simm.ac.cn).
PhD topic 6	**Structure-based drug discovery against viral proteases**

SIMM Supervisor	Prof. Dr. Yechun Xu
UNNC Supervisor(s)	Dr. Weihua Meng
Short introduction & description of PhD	Emerging and re-emerging viruses cause epidemics and pandemics worldwide, such as the ongoing pandemic COVID-19 and previously emerging MERS/SARS caused by coronavirus (CoV) infections, remaining the eminent threats to global public health and economies. The development of therapeutics and vaccines is particularly important for the prophylaxis and treatment of virus infections. Viral proteases are promising targets for the development of antiviral agents, and their inhibitors have been used for the treatment of HIV, HCV and COVID-19. More recently, Nirmatrelvir, an inhibitor of chymotrypsin-like main protease (3CLpro or Mpro) of SARS-CoV-2, in combination with ritonavir has been approved for the treatment of COVID-19. This project will focus on the inhibitor discovery targeting viral proteases, in particular the 3CLpro or 3Cpro involved in RNA viruses, using both the structure-based drug discovery strategy and bioinformatics tools, providing novel hit or lead compounds for antiviral drug development.
Contact points	Informal inquiries may be addressed to Dr/Prof Yechun Xu (ycxu@simm.ac.cn) and Dr Weihua Meng (Weihua.meng@nottingham.edu.cn).
PhD topic 7	**Synthesis of Furanocembranes and their Development as Anti-cancer Candidates**
SIMM Supervisor(s)	Dr Xuwen Li
UNNC Supervisor(s)	Dr. Bencan Tang
Short introduction & description of PhD	This project focuses on the biomimetic synthesis of polycyclic marine natural products for anti-cancer drug discovery purposes. Furanocembranes are a group of structurally complex and biologically important natural products. The potential of these being used for anti-cancer drugs or other medical application purposes have not yet been fully explored. This project involves the chemical synthesis of a group of furanocembranes with the potential to be developed into anti-cancer candidates. These synthesized furanocembranes could also be converted into more complex polycyclic natural products isolated from similar bio sources. The ideal candidate for this project would be a student who is with strong interest in organic synthesis and medical chemistry; who is hardworking and eager for success.
Contact points	Informal inquiries may be addressed to Dr. Xuwen Li (xwli@simm.ac.cn) and Dr. Bencan Tang (bencan.tang@nottingham.edu.cn).
PhD topic 8	**Wearable Patch with Biosensing and Drug Delivery Module for Management of Skin Cancer**
SIMM Supervisor(s)	Prof. Yongzhuo HUANG
UNNC Supervisor(s)	Dr. Sze Shin LOW
Short introduction & description of PhD	Melanoma is the most serious form of skin cancer, typically caused by ultraviolet radiation from natural sunshine or tanning beds and developed at the stratum corneum of epidermis (15–25 μm from the skin surface). Given the aggressive, recurrent nature and high metastatic rate of melanoma cells, it is of utmost

	importance to closely monitor and provide appropriate treatment for effective management of this skin cancer. The close monitoring of melanoma via detection of biomarker is vital for early diagnosis and prevention of advancement to metastatic melanoma. For instance, tumor necrosis factor receptor superfamily member TROY (TNFRSF19), which is aberrantly expressed in primary and metastatic melanoma cells and shed into the surrounding environment has been identified as a melanoma-specific biomarker. In addition, the detection of post-surgical residual cancer cells is also crucial for monitoring of melanoma progression. Surgery is a mainstay treatment for melanoma, but it has often seen the tumor recurrence and metastasis. Post-surgical intervention can lower the recurrence and metastasis rate. In this project, we plan to develop a drug-loaded hydrogel or flexible film that will be used for post-surgical implantation. By this means, it is expected to eradicate post-surgical residual cancer cells, as well as to enhance immune surveillance. We would also like to develop a method for stimuli-responsive controlled drug delivery via either physical control or biochemically triggered release.
Contact points	Informal inquiries may be addressed to Dr. Sze Shin Low (Sze-Shin.Low@nottingham.edu.cn) and Prof. Yongzhuo Huang (yzhuang@mail.shcnc.ac.cn).