Yuhan NIE

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EDUCATION

University of Chinese Academy of Sciences, China Sep 2022 – June 2025

Master in optical engineering

- Major courses: Frontiers of Medical Physics and Radiation Medicine
- Scholarships/Honors: Outstanding Student Cadres, Outstanding Freshman Scholarship, Academic Scholarship

University of Science and Technology of China, China Sep 2022 – June 2023

Study major courses

- Major courses: Information optics, Advanced Laser Technology, Engineering Optics, Digital Image Processing
- GPA:3.88/4.3

Peking University, China July 2023 – Sep 2023

Exchange Program

- Building a perfect focus system for super-resolution microscopy

Southwest University of Science and Technology, China Sep 2018– June 2022

Bachelor in optical engineering

- Major courses: Advanced Mathematics, Linear Algebra, Probability and Statistics, Methods of Mathematical Physics
- GPA: 3.70/5.0

PROFESSIONAL EXPERIENCE

Shanghai Institute of Optics and Fine Mechanics, University of Chinese Academy of Sciences

Molecular resolution microscopy based on SMLM, Independent study, *Professor Fu's group* Sep 2023 – present

- Developed a method based on single-molecule localization has been developed to achieve molecular-level resolution. This method is suitable for all SMLM.
- We first successfully demonstrated the theoretical feasibility of this method through simulations.
- By labeling different dye molecules at both ends of the ssDNA, we distinguished the sets of localization points of two adjacent fluorescent molecules by color and separately fitted the center positions of these localization point sets. This significantly improved localization precision and achieved molecular-scale resolution imaging.
- We fused different fluorescent proteins to the N-terminus and C-terminus of the FtsZ protein, achieving molecular-scale imaging resolution. Through experiments, we also found that this method enables distance measurements at the molecular scale.
- Our method for achieving molecular-scale resolution imaging based on dual-color SMLM is called MITI. We successfully advanced the resolution of optical microscopy to the molecular scale (2 nm-10 nm). Additionally, we found that our method is highly reliable for distance measurements at the molecular level, matching the measurement range of FRET, and it has the potential to serve as a complementary validation tool alongside FRET in the future.

Department of Biomedical Engineering, College of Future Technology, Peking University

Perfect focus system for polar-SIM, Independent study, *Professor Xi's group* July 2023 – Sep 2023

- Learned the theoretical knowledge and construction process of SIM, and participate in the development of Polar-SIM (P-SIM). Participate in and build the 3D Polar-SIM system, and learn how to design the SIM reconstruction algorithms.
- Led a project for developing an autofocus system for P-SIM, we use a 780nm near-infrared laser as a calibration beam, which is first reflected by the prism into the iris and projected onto the sample plane through the 4-f system. The reflected light from the sample returns through the iris and just avoids the prism and is reflected onto the line-CCD. We monitor the signal changes on the line-CCD and correct the focal plane in real time during imaging.

Department of Life Sciences and Medicine, University of Science and Technology of China

Investigate cell division mechanism through single-molecule techniques, Research assistant, Sep 2022 – June 2023

Professor Yang's group

- Learned the basic theoretical knowledge and basic experimental operations of cell biology and molecular biology, and be able to complete a full set of molecular cloning experiments and protein purification experiments
- Learned the experimental process and data analysis process of single molecule tracking in E. coli. Attempt to study the mechanism of cell division through single-molecule tracking.
- We performed PALM and STORM super-resolution imaging experiments on FtsZ in E. coli. We tried MINFLUX experiments on FtsZ with Alexa 647 in fixed cells. We tried to reveal the cell division mechanism through super-resolution imaging.

Department of Optical Engineering, Southwest University of Science and Technology

Graphene tunable biosensor design, Independent study, *Professor Yi's group* Oct 2021 – June 2022

- Designed a gear-type adjustable biosensor based on graphene metamaterial through FDTD solutions simulation. The designed graphene sensor has the potential to accurately identify biomolecules by detecting the shift in the SPR resonance wavelength. In the simulation, we simulate the change of refractive index to simulate the impact of different environments on sensor performance.
- Analyzed the optical properties and electric field distribution characteristics of the sensor. Then we analyzed the optical properties of graphene by adjusting the Fermi level and relaxation time of graphene, and demonstrated the tunability of the graphene sensor. We also explored the effect of the thickness of the dielectric layer on the optical characteristics of the sensor, and found that the graphene sensor we designed is insensitive to the polarization of the incident light, which theoretically increases its scope of application.
- Simulated the sensor in the near-infrared band of 1600nm-3000nm and found that the sensor has two perfect resonance modes with reflectivity as high as 96.9% and 92.84%. We also confirmed that the maximum refractive index sensitivity can reach 150 nm/RIU under the conditions of Fermi level of 0.80 eV, relaxation time of 0.80 ns, and dielectric layer thickness of 1000 nm.

Department of Optical Engineering, Southwest University of Science and Technology

Ga_2O_3/ZnO nanocomposite heterogeneous materials, Project leader, *Professor Yi's group* April 2020 – Oct 2021

- Produced Ga_2O_3/ZnO nanocomposite heterogeneous materials, and their properties were analyzed by SEM, XRD and Raman spectroscopy. The hydrophilicity of the material was tested by contact angle experiment. The optical properties of the material were then tested by UV spectrometer, and finally the photoelectric response characteristics of the material were tested to determine the potential of the material as anode for photovoltaic solar cells.
- The ZnO seed layer was sputtered on the FTO base by magnetron sputtering, and then ZnO nanorods were grown by hydrothermal method. On the grown ZnO nanorod sample, Ga_2O_3/ thin film was magnetron sputtered to finally form Ga_2O_3/ZnO nanocomposite heterogeneous material.
- Analyzed the experimental data and continuously optimized the experimental conditions. The photocurrent density of the composite material is twice that of pure zinc oxide nanorods. Due to the change in the energy band structure of the composite material and the reduction in the energy gap, the absorbance in the visible region is also significantly higher than that of pure zinc oxide nanorods.

Department of Optical Engineering, Southwest University of Science and Technology

ZnO/Bi_2O_3 Composites photoelectric properties, Project co-leader, *Professor Yi's group* April 2020 – Sep 2021

- After completing the project on Ga_2O_3/ZnO nanocomposites, we were attracted by the unique optoelectronic properties of Bi2O3, so we tried to use Bi_2O_3 as a thin film layer to continue studying the optoelectronic properties of ZnO/Bi_2O_3 nanocomposites.
- After analyzing the SEM morphology, XRD and Raman spectra of the materials, we further analyzed the photoelectric properties of the materials. We found that the ZnO/Bi_2O_3 nano-heterogeneous composite material also exhibited good photoelectric conversion properties, and the absorption spectrum was broadened from the ultraviolet spectrum to the visible spectrum, which is expected to be applied to photoelectric solar cells.

PUBLICATIONS

- **Yuhan Nie**, Guo Fu, Yuxin Leng. Nuclear Delivery of Nanoparticle-Based Drug Delivery Systems by Nuclear Localization Signals. Cells. 2023.
- **Yuhan Nie**, Yadong Xie, Zao Yi. Preparation of ZnO/Bi_2O_3 Composites as Heterogeneous Thin Film Materials with High Photoelectric Performance on FTO Base. Coatings. 2021.
- Yadong Xie[#], **Yuhan Nie**[#], Zao Yi. The influence of β-Ga_2O_3 film thickness on the optoelectronic properties of β-Ga_2O_3@ZnO nanocomposite heterogeneous materials. Materials Today Communications. 2021.(**# co-first author**)
- **Nie Y**, Hu J, Zhang S, Meng X, Fu G. Molecular resolution imaging based on two-color single-molecular localization microscopy (SMLM). Opt Express. 2025.

LEADERSHIP & GRANTS AWARDED

National Undergraduate Innovation Project: Effect of Ga_2O_3 film thickness on the optoelectronic properties of Ga_2O_3@ZnO nanocomposite heterogeneous materials

Project Leader Apr 2021 – Apr 2022

- I was fully responsible for all the work of the entire project, designed the experiment, completed the experiment, analyzed the experimental data, optimized the experiment, and wrote the paper.

National Undergraduate Innovation Project: Exploring the photoelectric properties of Bi_2O_3/ZnO nanocomposites

Main project participants Apr 2021 – Apr 2022

- Completed the experimental content, analyzed the experimental results, and organized the entire experimental data.

National Undergraduate Innovation Project: ZnO nanoarray based on Si inverted pyramid suede surface light trapping Structural Solar Cell Performance Research

Main project participants June 2020 – June 2021

- Analyzed the experimental data, wrote the project completion report, and completed the project completion work.

RESEARCH INTERESTS

- **Biophysics:** I have a great passion for biophysics. I am keen on using physical methods to explore advanced biological problems. At the same time, I am also very interested in the design and construction of optical systems and the research of related algorithms. In addition, I am also focused on the development of high-end medical equipment, which is also very attractive to me.
- **Next generation super-resolution technology:** I started to pay attention to super-resolution technology in my last year of undergraduate studies and found that it is a revolutionary technology for exploring biological problems. I have been focusing on super-resolution imaging technology throughout my master's career. In particular, super-resolution technology based on single-molecule imaging, such as DNA-PINT and MINFLUX, is clearly the leader in the next generation of super-resolution technology. I am eager to participating in the development of the next generation of microscopic imaging technology to explore biological problems at the molecular level.
- **Spatial omics research:** I have been following the frontier progress of spatial omics. I believe this will be another innovation in biophysics. Spatial omics has shown great ability in exploring biological problems, especially the development of spatial transcriptomics and spatial proteomics in recent years. Spatial omics seems to be another clever combination of imaging technology and life science problems. I am particularly interested in molecular-level spatial omics, and I also hope to have the opportunity to participate in the most cutting-edge research in spatial omics.

ADDITIONAL SKILLS

- **Technical:** MATLAB, Python, C++, FDTD, LabVIEW, SolidWorks, Origin, Photoshop, ImageJ, Snapgene, etc.
- **Laboratory Skills:** Build microscope system, Molecular cloning, Protein purification, Raman spectroscopy imaging, XRD spectrum analysis, Magnetron sputtering coating, Clean room experience.
- **Languages:** English (Fluent), Mandarin (Native), Chinese Others (Native)
- **Interests:** Exercising, Swimming, Basketball.