Pengcheng Zhao, PhD

zpc1993@live.cn / zhaopc@buaa.edu.cn pczhao.cn (86) 13126822622 / (852) 51312272
HJ805, The Hong Kong Polytechnic University, Hong Kong

About me

- I am currently a Postdoctoral Fellow at the Hong Kong Polytechnic University (PolyU), collaborating with Prof. Jin Wei and Prof. Zhang Aping. My research interests focus on laser spectroscopy, fiber-optic sensors and devices. I've participated in 4 research grants, published 10 peer-reviewed journal papers such as *Nature Communications*, *Laser & Photonics Reviews* (2023, 2024), *Photoacoustics*, and *Optics Letters*, and co-authored 2 national patents. I also serve as a reviewer for international journals such as *Optics & Laser Technology*, *Sensors and Actuators A: Physical*. Throughout my academic career, I was the recipient of numerous national scholarships and awards, including **Humboldt Research Fellowship for Postdocs**, "**China's Top 10 Optical Breakthrough in 2020**", the **Best Oral Presentation Awards** in the 12th Optical Fiber Sensors Conference China (OFS-China 2024), and the **Excellent Doctoral Thesis Award** of Beijing as well as BUAA in 2023.

Employment History

04/2022 – now
- **Postdoctoral Fellow** at Department of Electrical and Electronic Engineering, **PolyU**, Hong Kong, China.

Academic Qualifications

09/2015 – 01/2022
- **PhD** in Engineering (after 09/2017) & Master study in Engineering (before 09/2017) (Supervisor: Prof. Shangchun Fan), School of Instrumentation and Optoelectronic Engineering, **BUAA**, China.
  Thesis title: *Investigation on fiber-optic photothermal interferometry for high sensitivity gas detection.*

07/2017 – 01/2021
- **Visiting scholar** in Prof. Jin Wei group (PhD Joint Supervision) at Department of Electrical Engineering, **PolyU**, Hong Kong, China.

09/2011 – 07/2015
- **Bachelor** of Engineering, College of Instrumentation & Electrical Engineering, **Jilin University**, China.

Research Highlights

- **Hollow-core Fiber Photothermal Spectroscopy for Ultrasensitive Gas Detection**
  Proposed a hollow-core fiber (HCF) based Mode-phase-difference photothermal spectroscopy (MPD-PTS) for gas sensing; Developed mathematical models to analyze the sensitivities of the MPD between the probe LP_{01} and LP_{11} modes to pump absorption and environmental perturbations, and found that the MPD is sensitive to the gas absorption inside the hollow-core but not sensitive to the external disturbances, considerably improving the signal-to-noise ratio and stability. With meters-long HCFs, MPD-PTS has demonstrated trace acetylene detection limit of 15 parts per trillion, < 1% instabilities over 3 hours, response time of < 47 seconds and dynamic range of over 7 orders of magnitude, making it the most sensitive HCF spectroscopic gas sensor with the largest dynamic range to date. The results were published in *Nature Communications* and have garnered 191 citations on Google Scholar as of 2024-11-20. The work was recognized as a "landmark contribution" by reviewer and awarded the " China's Top 10 Optical Breakthroughs in Optics" in 2020. This publication elevates my academic profile with awards, citations, and recognition, establishing me as an expert in optical fiber sensing.

Research Highlights (continued)

Evanescent Wave Lab-on-Fiber for High Sensitivity Gas Spectroscopy
Proposed a microfiber (MNF) based MPD-PTS for gas detection; Developed a mathematical model to analyze the sensitivities of the MPD between the probe HE11 and HE12 modes to evanescent-wave absorption, and found that MNF-based MPD-PTS has a larger photothermal efficiency at low modulation frequency and shorter gas filling time than HCF-based MPD-PTS. With a centimeters-long tapered MNF, MNF-based MPD-PTS has demonstrated methane detection limit of 160 ppb, < 3% instability over 7 days, response time of < 6 s and dynamic range of over 6 orders of magnitude, making it the most sensitive evanescent-wave gas sensor with the largest dynamic range and fastest response to date. The results were published in *Laser & Photonics Reviews*, marking an extension of my research interests from hollow-core fiber to optical microfiber.

Ultraminiature Optical Fiber-Tip 3D-Microprinted Photothermal Gas Sensor
Proposed an ultraminiature optical fiber-tip photothermal gas sensor via direct 3D micro-printing of a Fabry-Pérot cavity on the end face of a standard single-mode optical fiber. It enables not only direct interaction between light and gas molecules at the fiber output but also remote interrogation through an interferometric read-out scheme. With a low-finesse microcavity of 66 μm in length, a detection limit of 160 ppb acetylene gas is demonstrated with an ultra-fast response time of 0.5 s. The results were published in *Laser & Photonics Reviews*, opening up new possibilities for trace-gas sensing in many space-constrained applications, such as in-reactor or battery monitoring and medical diagnosis, and offer a plug-and-play solution for seamless integration into various scenarios requiring regular inspection.

Research Publications

Journal Articles

1. **P. Zhao**, Y. Zhao, H. Bao, H. L. Ho, W. Jin*, S. Fan*, S. Gao, Y. Wang, and P. Wang, "Mode-phase-difference photothermal spectroscopy for gas detection with an anti-resonant hollow-core optical fiber," *Nature communications*, vol. 11, no. 1, pp. 1–8, 2020.
2. **P. Zhao**†, K. V. Krishnaiah†, L. Guo, T. Li, H. L. Ho, A. P. Zhang*, and W. Jin*, "Ultraminiature optical fiber-tip 3d-microprinted photothermal interferometric gas sensors," *Laser & Photonics Reviews*, p. 202 301 285, 2024.
3. **P. Zhao***, H. L. Ho, S. Fan, and W. Jin*, "Evanescent wave lab-on-fiber for high sensitivity gas spectroscopy with wide dynamic range and long-term stability," *Laser & Photonics Reviews*, p. 2 200 972, 2023.
4. T. Li†, **P. Zhao**†, P. Wang, K. V. Krishnaiah, W. Jin*, and A. P. Zhang*, "Miniature optical fiber photoacoustic spectroscopy gas sensor based on a 3d micro-printed planar-spiral spring optomechanical resonator," *Photoacoustics*, vol. 40, p. 100 657, 2024.
5. L. Guo, **P. Zhao***, H. L. Ho, S. Jiang, H. Bao, S. Gao, Y. Wang, and W. Jin*, "Pump-probe-alternating photothermal interferometry for two-component gas sensing," *Optics Letters*, vol. 48, no. 24, pp. 6440–6443, 2023.
6. **P. Zhao**, H. L. Ho, W. Jin*, S. Fan*, S. Gao, and Y. Wang, "Hollow-core fiber photothermal methane sensor with temperature compensation," *Optics Letters*, vol. 46, no. 11, pp. 2762–2765, 2021.
7. **P. Zhao**, H. L. Ho, W. Jin*, S. Fan*, S. Gao, Y. Wang, and P. Wang, "Gas sensing with mode-phase-difference photothermal spectroscopy assisted by a long period grating in a dual-mode negative-curvature hollow-core optical fiber," *Optics Letters*, vol. 45, no. 20, pp. 5660–5663, 2020.
8. P. Wang, T. Li, H. Lin, **P. Zhao**, S. Liu, H.-Y. Tam, and A. P. Zhang*, "Miniature optical fiber accelerometer based on an in-situ 3d micro-printed ferrule-top fabrypérot microinterferometer," *Light: Advanced Manufacturing*, 2025 (In press).
9. L. Guo, H. Bao, F. Chen, **P. Zhao**, S. Jiang, H. L. Ho, and W. Jin, "Ultra-compact optical fiber gas sensor with high sensitivity, fast response and large dynamic range," *Journal of Lightwave Technology*, 2023.

10. W. Jin*, H. Bao, **P. Zhao**, Y. Zhao, Y. Qi, C. Wang, and H. L. Ho, "Recent advances in spectroscopic gas sensing with micro/nano-structured optical fibers," *Photonic Sensors*, pp. 1–17, 2021.

11. W. Jin*, H. Bao*, Y. Qi, Y. Zhao, **P. Zhao**, S. Gao, and H. L. Ho, "Micro/nano-structured optical fiber laser spectroscopy," *Acta Optica Sinica*, vol. 41, no. 1, pp. 1–18, 2021.

Conference Proceedings

1. **P. Zhao**†, K. V. Krishnaiah†, L. Guo, T. Li, H. L. Ho, A. P. Zhang*, and W. Jin*, "High-sensitivity fiber-tip photothermal gas sensor based on a 3d μ-printed fabry-pérot microcavity," in *Optical Fiber Sensors*, Optica Publishing Group, 2023, Th5–2.

2. L. Guo, **P. Zhao***, H. L. Ho, S. Jiang, H. Bao, S. Gao, Y. Wang, and W. Jin*, "Two-component photothermal gas sensor with a pump-probe-alternating technique," in *Optical Fiber Sensors*, Optica Publishing Group, 2023, Tu3–16.

3. **P. Zhao**, S. Fan, H. L. Ho, and W. Jin*, "Microfiber evanescent-wave photothermal methane sensor with sub-ppm sensitivity," in *Optical Fiber Sensors*, Optica Publishing Group, 2022, Th3–5.

4. **P. Zhao***, H. L. Ho, W. Jin, S. Fan, S. Gao, Y. Wang, and P. Wang, "Lp01-lp11 mode conversion in a negative curvature hollow-core fiber by use of a long-period grating," in *Asia Communications and Photonics Conference*, Optica Publishing Group, 2020, M4A–118.

5. **P. Zhao***, Y. Zhao, H. Bao, H. L. Ho, W. Jin, S. Fan, S. Gao, Y. Wang, and P. Wang, "Ultrasensitive photothermal gas sensor with a dual-mode anti-resonant hollow-core fiber," in *Optical Fiber Sensors*, Optica Publishing Group, 2020, W3–7.

6. T. Li, K. V. Krishnaiah, **P. Zhao**, and A. P. Zhang, "Optical fiber ferrule-top spirally-suspended optomechanical microresonators for photoacoustic spectroscopic gas sensing," in *The European Conference on Lasers and Electro-Optic(CLEO/Europe 2023)*, Optica Publishing Group, 2023, ch_14_4.

7. W. Jin*, H. Bao, **P. Zhao**, Y. Qi, and H. L. Ho, "High sensitivity gas detection with microstructured optical fibres," in *2020 22nd International Conference on Transparent Optical Networks (ICTON)*, IEEE, 2020, pp. 1–4.

Granted Patents

- W. Jin, **P. Zhao**, H.L. Ho. "A method and system for detecting fluid concentration." ZL201911243218.9 (In Chinese), 2024.

- S. Fan, **P. Zhao**, W. Xing. "A double graphene resonant beam pressure sensor." CN106918420B (In Chinese), 2019.

Project Experiences

12/2024 to present — **Study of gassing dynamics in rechargeable batteries with embedded optical fiber sensors** PolyU Academy for Interdisciplinary Research (PAIR) (1-CDJ6) (Participation).

04/2022 to 12/2024 — **Optical Fiber Biomedical Sensing and Imaging Technologies** National Natural Science Foundation of China (NSFC) (K-ZGAV) (Participation).

04/2022 to 04/2024 — **PolyU Postdoc Matching Fund (PDF) Scheme** PolyU(1-W23B) (Technical Leader).

Project Experiences (continued)

01/2019 to 12/2023 — **Microstructured hollow-core optical fiber multi-component trace gas analyzer** NSFC National Major Project for Research Instrument Development(61827820), HK$7m (Participation).

07/2017 to 10/2018 — **Research on Optical Fiber Angle Sensor Based on Graphene Diaphragm** Joint Supervision Scheme with the Chinese Mainland, Taiwan and Macao Universities(1-ZVG4), HK$180,600 (Technical Leader).

Awards and Achievements

2024 — **Best Oral Presentation Awards**, OFS-China 2024, Chinese Society for Optical Engineering
Humboldt Research Fellowship for Postdocs, Alexander von Humboldt-Stiftung, Germany

2023 — **Best Doctoral Thesis Award of Beijing**, Beijing Municipal Education Commission
Best Doctoral Thesis Award of BUAA, Beihang University

2021 — **China's Top 10 Optical Breakthroughs**, Chinese Laser Press
Top 10 Outstanding Graduate Students, Beihang University

2020 — **National scholarship for postgraduate student**, Ministry of Education of China

Conference Talks

09/2024 — **12th Optical Fiber Sensors Conference China (OFS-China 2024)**, Chongqing, China

11/2023 — **28th International Conference on Optical Fiber Sensors (OFS)**, Hamamatsu, Japan

08/2022 — **27th OFS**, Virginia, United States (Online)

Teaching Experiences

2024 — **New sensing technology**, Undergraduate course, Online
Lecturer, Chapter 10.3 Laser Photothermal Interferometric Fiber-optic Gas Sensing Technology, BUAA.

2023 — **Sensor technology and applications**, Undergraduate course, Online
Lecturer, Chapter 6.11 Microstructure optical fiber gas sensor, BUAA.

2018 - 2020 — **Applied Electromagnetics**, Undergraduate course, PolyU
Teaching Assistant

Services

Journal Reviewer — Optics & Laser Technology, Sensors and Actuators A: Physical