



## Manik Pradhan

Associate Professor  
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Dr. Pradhan received his PhD from the University of Bristol, UK (2008), having been awarded a prestigious Dorothy Hodgkin Fellowship. He did his postdoctoral works at University of Cambridge, UK (2008-2010) and Stanford University, USA (2010-2011). He also worked as a Visiting Research Assistant (2004-2005) at the Institute of Atomic and Molecular Sciences (IAMS), Academia Sinica, Taiwan. He is currently leading many multi-disciplinary research projects as a Principal Investigator (PI) as well as a Co-PI. He is also one of the Activity Leaders and Associate Nodal Officers of the Technical Research Centre (TRC) at S. N. Bose Centre.

### Supervision of Research / Students

#### Ph.D. Students

1. Gourab Dutta Banik
2. Abhijit Maity
3. Suman Som
4. Chiranjit Ghosh
5. Mithun Pal

6. Sanchi Maithani
7. Santanu Mandal
8. Akash Das
9. Sasthi Charan Mandal
10. Ikbal Ahmed

### Teaching activities at the Centre

1. PHY 391 (METHODS OF EXPERIMENTAL PHYSICS) (shared)

### Publications in Journals

1. G. Dutta Banik, S. Som, A. Maity, M. Pal, S. Maithani, S. Mandal, **M. Pradhan**; *An EC-QCL based  $N_2O$  sensor at  $5.2 \mu m$  using cavity ring-down spectroscopy for environmental applications*; Analytical Methods; 2017; **9**; 2315.
2. A. Maity, M. Pal, S. Som, S. Maithani, S. Chaudhuri, **M. Pradhan**; *Natural  $^{18}O$  and  $^{13}C$ -urea in gastric juice: a new route for non-invasive detection of ulcer*; Anal. and Bioanal. Chem.; 2017; **409**(1); 193-200.
3. C. Ghosh, S. Mandal, G. D Banik, A. Maity, P. Mukhopadhyay, S. Ghosh, **M. Pradhan**; *Targeting erythrocyte carbonic anhydrase and  $^{18}O$ -isotope of breath  $CO_2$  for sorting out type 1 and type 2 diabetes*; Scientific Reports (Nature Publishing Groups); 2016; **6**; 35836.
4. A. Maity, M. Pal, S. Maithani, B. Ghosh, S. Chaudhuri, **M. Pradhan**; *Molecular hydrogen in human breath: a new strategy for selectively diagnosing peptic ulcer disease, non-ulcerous dyspepsia and Helicobacter pylori infection*; J. Breath. Res.; 2016; **10**; 036007.
5. G. D. Banik, A. De, S. Som, S. Jana, S. B. Daschakraborty, S. Chaudhuri and **M. Pradhan**; *Hydrogen sulphide in exhaled breath: a potential biomarker for small intestinal bacterial overgrowth in IBS*; J. Breath. Res.; 2016; **10**; 026010.
6. A. De, G. Banik, A. Maity, M. Pal and **M. Pradhan**; *Continuous wave external-cavity quantum cascade laser-based high-resolution cavity ring-down spectrometer for ultrasensitive trace gas detection*; Optics Letters; 2016; **41**(9); 1949.

### Lectures Delivered

1. Invited Speaker: International Conference on Perspectives in Vibrational Spectroscopy; ICOPVS 2016; Lucknow, India.

### Patent/s submitted / granted

1. **File No:** 201631038296; **Title on the invention:** "Dioxo vanadium (V) complex as carbonic anhydrase inhibitor".

### Awards / Recognitions

1. WIDF-Innovation Award by World India Diabetes Foundation (WIDF), USA: (2017)

### Sponsored Projects

#### (1) Ministry of Earth Sciences (MoES): 2013-2017

**Title:** "Development of a mid-IR Cavity Ring-down Spectrometer for High-Precision Real-Time Continuous Monitoring of Multiple Trace Gases and Stable Isotopic Species in the Atmosphere".

**(2) Department of Biotechnology (DBT), RGYI Scheme: 2013-2016**

**Title:** “Cavity Ring-Down Spectroscopy for Real-Time Breath Analysis: a Next-Generation Diagnostics in Modern Medicine”.

**(3) RSSDI (Research Society for the study of Diabetes in India):2015-2017**

**Title:** “Non-invasive detection of diabetes mellitus from breath analysis using cavity enhanced absorption spectroscopy”

**(4) Department of Science and Technology (DST), Government of India: 2015-2018**

**Title:** “New-frontiers in quantitative mid-IR high-resolution cavity ring-down spectroscopy using quantum cascade laser”.

**Member of Editorial Board**

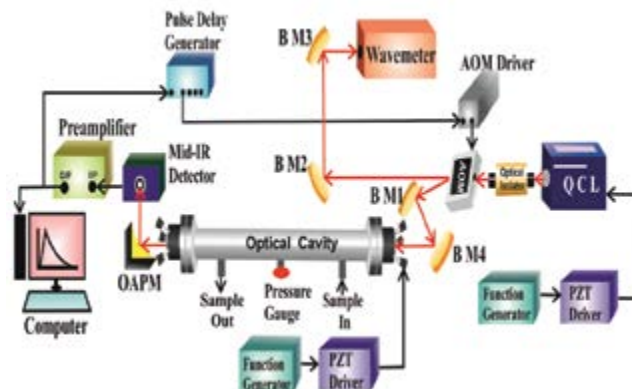
1. Scientific Reports (Nature Publishing Group)
2. World Journal of Gastroenterology

**Significant research output / development during last one year**General research areas and problems worked on

- Cavity Ring-Down Spectroscopy (CRDS)
- High-Resolution Quantum Cascade Laser (QCL) Spectroscopy
- Evanescent wave and Nano-Biophotonics
- Biomedical Optics and Clinical Diagnostics
- Human Breath Analysis
- Trace gas sensing and isotope ratio measurements

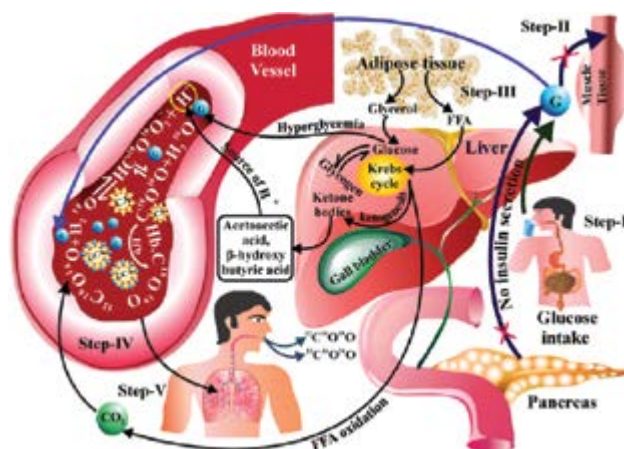
Interesting results obtained

- (1) We have developed a high-resolution cw-CRDS system coupled with an external-cavity quantum cascade laser (EC-QCL) as shown in Fig.1 for ultra-sensitive trace gas detection for environmental monitoring and biomedical science applications. The CRDS system has been utilized for simultaneous and molecule-specific real-time detection of several trace molecular species such as nitric oxide (NO), nitrous oxide (N<sub>2</sub>O), carbonyl sulphide (OCS) and acetylene (C<sub>2</sub>H<sub>2</sub>) from parts-per-billion (ppb) to parts-per-trillion (ppt) levels by probing numerous rotationally resolved ro-vibronic transitions in the mid-IR spectral region.



**Fig.1** The quantum cascade laser based CRDS system developed in my laboratory

- (2) We have shown that oxygen-18 (<sup>18</sup>O) in human breath CO<sub>2</sub> regulated by the carbonic anhydrase (CA) activity is a potential diagnostic biomarker that can selectively and precisely distinguish type 1 and type 2 diabetes patients. The potential metabolic pathways involving the alternation of <sup>18</sup>O isotopes in breath CO<sub>2</sub> is depicted in Fig.2



**Fig.2** Proposed physiological pathways of oxygen-18 isotopic fractionation in diabetes.

Proposed research activities for the coming year

We are currently developing some novel spectroscopic techniques using diode and QC lasers for fundamental understanding of high-resolution molecular spectroscopy and hyper-fine structures of the molecular species.