Pramod P. Wangikar

Chair Professor for Green Chemistry and Industrial Biotechnology,
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Currently on Sabbatical at: Rensselaer Polytechnic Institute, Troy, NY, USA.

Summary

Dr. Wangikar is the Chair Professor for Green Chemistry and Industrial Biotechnology at the Department of Chemical Engineering, IIT Bombay. An elected fellow of the Indian National Academy of Engineering, Dr. Wangikar has an extensive research portfolio with over 130 peer-reviewed publications, focusing on advanced areas of metabolomics, bioprocess development, and metabolic engineering. His current research endeavours include the identification of severity biomarkers for diabetes through metabolomic profiling and precision fermentation with spent media metabolomics and metabolic modeling. Dr. Wangikar has also worked extensively on metabolic engineering and ^{13}C metabolic flux analysis (^{13}C MFA) of cyanobacteria. Dr. Wangikar heads the Biosystems Engineering laboratory at IIT Bombay that is well equipped with LCMS (both HR and Triple quadrupole), GCMS with headspace, lab-scale fermenters, PCR, and other analytical instruments. In addition to his academic research, Dr. Wangikar is actively involved in translational research and entrepreneurship.

Scientific Contributions and Current Work

Prof. Pramod P. Wangikar's research integrates LC-MS–based metabolomics, genome-scale metabolic modeling, and AI and machine learning to advance both industrial biotechnology and human health. His group combines analytical chemistry, metabolic modeling, and data science to derive mechanistic and predictive insights into microbial and mammalian metabolism. This foundation supports applications in **bioprocess optimization**, **human biology**, and **metabolomics-driven diagnostics**.

His lab has developed comprehensive **LC-MS and GC-MS pipelines** capable of quantifying >400 metabolites in microbial, mammalian, and clinical samples. Further, the team uses ^{13}C isotope tracing and SWATH-MS to quantify fragment-level isotopic enrichment and flux analysis via **isotopically non-stationary ^{13}C metabolic flux analysis (INST-MFA)**.

To enable scalable metabolomics analysis, his team developed **MSOne**—a cloud-based, vendor-agnostic, and scalable AI/ML-powered platform for LC-MS data analysis. MSOne is freely available software and has over 100 active users. It's features include:

- **MetaExplorer**: Data quality check and chromatogram exploration – to be used for daily checks on the HR-LCMS data.

- **MetAnalyzer**: Deep learning–based preprocessing (U-Nets, CNNs) – can scale upto thousands of LCMS files.
- **MetaStat**: Statistical analysis, clustering, classification, plotting and biomarker discovery.
- **MetaMine**: Mining and standardized reanalysis of public metabolomics repositories (e.g., MetaboLights, Metabolomics Workbench) to build a **queryable reference database** for clinical and microbial datasets.

In photoautotrophic systems, Wangikar's group developed curated genome-scale models and applied INST-MFA to cyanobacterial strains under diurnal cycles and stress conditions. A landmark *iScience* (2020) study revealed time-of-day–specific flux rewiring, and subsequent *Plant J.* (2022) work discovered dynamic γ-glutamyl peptides as nitrogen reservoirs.

1. Dynamic Inventory of Intermediate Metabolites in a Diurnal Cycle – *iScience*, 2020
2. Probing the metabolism of γ-glutamyl peptides in cyanobacteria via metabolite profiling and ^{13}C labeling – *Plant J.*, 2022
3. Isotopically non-stationary ^{13}C metabolic flux analysis of two closely related fast-growing cyanobacteria– *Plant J.*, 2023
4. SWATH MS workflow for quantification of ^{13}C labeling in intracellular metabolites and fragments, *ACS Analytical Chemistry*, 2018
5. Intracellular metabolomic profiling of a green alga under diurnal conditions, *Metabolomics*, 2024.

In bioprocess engineering, a series of papers integrates spent media metabolomics with dynamic flux balance analysis (dFBA) to model and optimize recombinant protein production. These include:

1. Model-based optimization using spent media analysis, *Biotechnol. Bioeng.*, 2023
2. Dynamic flux balance analysis with mass spectrometry-based spent media analysis, *Biotechnol. Bioeng.*, 2024
3. Process intensification by identifying active metabolic nodes, *Biotechnol. Bioeng.*, 2025

Together, these works enable predictive strain design and process design, aligning well with precision manufacturing and scalable biotherapeutic production—an interest shared by the translational science community.

In clinical systems biology, Prof. Wangikar's team has worked on metabolic health, diabetes, and cancer. He has ongoing projects to identify biomarkers to predict the complications arising out of type 2 diabetes. Further, a recently accepted manuscript on cervical cancer reports niacinamide as a tumor-grade–specific metabolic biomarker, suggesting potential metabolite-guided therapeutic strategies.

Prof. Wangikar's multidisciplinary program offers clear synergy with systems medicine, data-driven diagnostics, and personalized therapeutics, and is well-positioned for collaboration on metabolomics-guided discovery, multi-omics integration, and clinical ML pipelines.

Education

Ph.D. (Chemical & Biochemical Engineering), University of Iowa, USA	1995
B.Tech (Chemical Engineering), University Department of Chemical Technology (UDCT), Mumbai, India	1991

Professional Experience

Professor, Indian Institute of Technology Bombay, Mumbai	Feb 2009-Present
Associate Professor, Indian Institute of Technology Bombay, Mumbai	Mar 2003-Feb 2009
Assistant Professor, Indian Institute of Technology Bombay, Mumbai	Dec 1997-Mar2003
Visiting Faculty (on sabbatical from IIT Bombay), Department of Chemical Engineering, University of Delaware, USA	Jan - Dec 2004
Assistant Professor, Indian Institute of Technology Kanpur	July 1996 - Dec 1997
Scientist, EnzyMed Inc. USA	May 1995 - July 1996

Publications: https://scholar.google.com/citations?hl=en&user=BlbHDhsAAAAJ

Technology/Products/Patents

1. Bose M, Wangikar P, Ratde H, Patankar H, An annular photobioreactor for indoor and outdoor applications. Indian Patent No. 482718 (Patent Granted)
2. Wangikar P, Ganjave S. Recombinant promoters for inducer-free expression of proteins and uses thereof. Indian Patent No.: 548180 (Patent Granted)
3. Wangikar P, Sengupta S, Madhu S, Sahasrabuddhe D, Jaiswal D, Method for photoautotrophic production of succinate using recombinant Synechococcus sp. Indian Patent Application No. 202121022027, Filed on 17th May 2021
4. Wangikar P, Ganjave S, Dodia H, A High-Cell-Density cultivation method and system. Indian Patent Application No. 202121031031, Filed on 10th July 2021
5. Wangikar P, Patil S, Nakrani P, Identifying and quantifying peak properties of mass spectrometry data in m/z vs intensity dimension (Full Specifications filed)
6. Wangikar P, Patil S, Identifying and quantifying peak properties of mass spectrometry data in retention time dimension (Provisional Patent Filed)
7. Wangikar P., Patil S., Identifying and quantifying peak properties of mass spectrometry data in drift time vs intensity domain (Provisional Patent Filed)

Students guided (PhD): 34

Administrative positions and Committees

- Professor-in-charge (PIC), Wadhwani Research Center for Bioengineering (WRCB); Aug 2014-2022
- Coordinator, Virtual Pan-IIT centre for Bioenergy; 2014-present
- Pramod Chaudhuri Chair Professor in Green Chemistry and Industrial Biotechnology (IIT Bombay); 2024-present

Conferences Organized

1. International Conference on Metabolomics and Lipidomics (ICML2025) at IIT Bombay; February 24-26, 2025
2. IITB Biopharma Summit at IIT Bombay; November 23-24, 2023
3. Indo-US workshop on cell factories at IIT Bombay; March 18-20, 2016
4. Indo-US workshop "Cyanobacteria: molecular networks to biofuels" at Lonavala, India; December 16-20, 2012

Awards and Recognition

- Institute Chair Professor, IITB (2022-present)
- Fellow of INAE (2023)
- National Bioscience Award for Career Development, 2006 (DBT, Government of India).
- EMBO short term fellowship, 2006.
- IIT Bombay Young Researcher Award 2005
- INAE Young Engineer Award, 2005.
- R. G. Manudhane Excellence in Research Award, IIT Bombay, 2005.
- BOYSCAST fellowship (DST, Govt of India) to visit University of Delaware, USA (2004).

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