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Department: Civil and Environmental Engineering

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Broad area: Development of a non-thermal atmospheric pressure plasma reactor for the treatment of food contaminated with mycotoxins

Year of joining Ph. D program: January 2022

PhD Advisor: Dr. Shihabudheen M. Maliyekkal and Dr. Reetesh Kumar Gangwar



1. Academic Background:

I completed my under graduation in Civil Engineering from Bapatla Engineering College. During my undergraduate studies, I showed much interest in Environmental Engineering. The problems that the world is facing due to several pollutants in the environment made me think deeply about the subject. Then I realized that research is the gateway to finding solutions for unsolved problems. I was also convinced during my undergraduate project that access to state-of-the-art facilities is a critical factor for doing quality research. Therefore, I decided to pursue higher studies in Environmental Engineering at a premier Institute like IIT. I got admitted to IIT Tirupati for my M.Tech in Environmental and Water Resources Engineering program and started my M.Tech project with the Guidance of Dr. Shihabudheen M. Maliyekkal and Dr. Prassana Venkatesh Sampath. My M.Tech project is about the synthesis and application of nanomaterials for the removal of uranium from groundwater by using the adsorption technique. Currently, I am writing a research article based on the results of my M.Tech work and published a review paper on uranium removal technologies from groundwater with an impact factor of 7.96 (in 2020). After graduation, from M.Tech I continued to work as JRF at IIT Tirupati for 6 months and joined as a Ph.D. scholar at IIT Tirupati (January 2022). My PhD topic is about the application of non-thermal atmospheric pressure plasma for the treatment of food items contaminated with mycotoxins.

2. Research Interest/Broad Area

- Water and wastewater treatment
- Non-thermal plasma application in food processing
- Adsorption
- Waste management
- Modeling and optimization of plasma parameters
- Toxicity effect of plasma on food processing

3. Advisor Information

a) Shihabudheen M. Maliyekkal:

Dr. Shihabudheen M. Maliyekkal is an Assistant Professor in the Civil and Environmental Engineering Department at the Indian Institute of Technology Tirupati. He earned his master's and Ph.D. from the Indian Institute of Technology Madras in Environmental Engineering. His research aims to address the challenging task of providing safe water for all. One of his arsenic removal technologies has been implemented in the field, and more than one million affected people benefit from the invention. He has extensive experience synthesizing and characterization of nanoscale materials and their application in water and wastewater purification. Besides water and wastewater treatment, his interests include developing sustainable construction and repair materials. Dr. Maliyekkal has authored over 70 articles in reputed journals and conference proceedings, and he is an inventor/co-inventor in 17 patents or patent applications. He has edited one book and authored/co-authored 14 book chapters. He is one of the founding directors of an IIT Tirupati incubated start-up NGEN Water Solutions Pvt. Ltd.

Areas of Interest

- Water and Wastewater Treatment
- Advanced Materials for Environmental Remediation
- Sustainable Materials for Energy and Civil Engineering Applications
- Reuse and Recycling of Materials
- Toxicity Effect of nanoscale Materials on Conventional Wastewater Treatment Processes
- Application of Plasma in Environmental Remediation

b) Reetesh Kumar Gangwar

Dr. Reetesh Kumar Gangwar is an Assistant Professor & Head in the Physics Department at the Indian Institute of Technology Tirupati. He earned his Ph.D. from the Indian Institute of Technology Roorkee in Physics. He has extensive experience in developing various non-thermal plasma systems. He is also an expert in carrying out plasma diagnostics using spectroscopy-based techniques. Dr. Gangwar has developed both experimental and theoretical skills required to characterize and develop plasma reactors. He has recently developed atmospheric pressure plasma systems for food processing and water treatment at IIT Tirupati. Dr. Gangwar has published more than 30 papers in the leading peer-reviewed journals in the field.

Areas of Interest

- Atomic and Molecular Physics
- Plasma Physics
- Plasma modeling & spectroscopy-based characterization
- Atomic structure calculation
- Calculation of atomic processes relevant for plasma modeling
- Ion trapping and cooling
- Study of non-thermal plasmas employed in environmental and food processing applications
- Study of high-density plasmas employed in the synthesis of nano-sized materials

4. Thesis objectives

- Development of a sustainable Non-Thermal Atmospheric Pressure Plasma (NTAP) reactor for decontaminating mycotoxins from agricultural food products
- Optimization of plasma parameters through non-invasive spectroscopic methods to achieve optimal plasma operating conditions to remove mycotoxins without compromising the food quality

5. Teaching Assistantships

CE5104 - Physicochemical Processes in Water and Wastewater Engineering

CE5202 - Biological Processes in Wastewater Engineering

CE5291 - Environmental Monitoring Laboratory

ES2103 - Ecology and Environment

6. Future Plans

- Development of a flexible NTAP reactor for the direct and indirect treatment of aflatoxins from agricultural food products
- Demonstrate the application of NTAP for the detoxification of aflatoxin taking groundnut as a model agricultural product in batch and continuous reactors
- Study the cost analysis to check the economic viability of the process

7. List of Patents/Publications

- Naga Jyothi, M.S.V¹., Gayathri, S¹., **Gandhi, T.P¹**., Maliyekkal, S.M. (2021) Dissolved Arsenic in Ground-water Bodies: A Short Review of Remediation Technologies. In: Singh S.P., Rathinam K., Gupta T., Agarwal A.K. (eds) Pollution Control Technologies. Energy, Environment, and Sustainability. Springer, Singapore. https://doi.org/10.1007/978-981-16-0858-2_5. (¹Equally contributed)
- **Gandhi, T.P.**, Sampath, P.V., Maliyekkal, S.M. (2022) A critical review of uranium contamination in ground-water: Treatment and sludge disposal. *Science of The Total Environment*, 2022, 825, 153947. <https://doi.org/10.1016/j.scitotenv.2022.153947>
- **Gandhi, T.P.**, Gomosta, S., Sengupta, S., Maliyekkal, S.M. (2022) A scalable and affordable method for production of graphene oxide: Application in the removal of aqueous uranium. In Roorkee Water Conclave, March 02-04, 2022, Department of Hydrology, IIT Roorkee
- **Gandhi, T.P.**, Sampath, P.V., Maliyekkal, S.M. (2022) A review on remediation of uranium from groundwater using nanoscale materials. In International Conference on Environmental Science and Engineering, January 20-22, 2022, Environmental Science and Engineering Department, IIT Bombay

8. Papers in preparation.

- **Gandhi, T.P.**, Naga Jyothi, M.S.V., Gomosta, S., Maliyekkal, S.M. (2022) A low-cost and scalable combustion-based graphene oxide aerogel for efficient uptake of U(VI) ions

- **Gandhi, T.P.**, Arwa, S., Gangwar, R.K., Maliyekkal, S.M. (2022) A critical review on application of non-thermal plasma technology in food processing: Prospects and challenges