

Synergistic Degradation of Dyes with Marine Bacteria Incubated in Graphene Oxide Matrix

Neha Redkar¹, MADHURIMA DEB¹, Cathrine Manohar², Ashok Shivaaji Jagtap³, Sumit Saxena¹, and Shobha Shukla¹

¹Indian Institute of Technology Bombay

²CSIR-National Institute of Oceanography

³CSIR-National Institute of Technology, Goa

December 7, 2022

Abstract

Graphene or graphene-based nanomaterials have emerged as novel scaffolds for developing robust bio-catalytic systems and a fast-developing promising contender for bioremediation. The interaction of bacteria and graphene is such an elusive issue that its implication in environmental biotechnology is unclear. The complexity and recalcitrant nature of the dyes make the conventional techniques inadequate and remain a challenge for industrial effluent treatment. Many scientists have developed hybrid processes and hybrid materials to enhance the treatment processes to satisfy increasingly stringent laws and criteria related to effluent discharge. The current study explicitly focuses on immobilization and growth of dye-degrading marine bacterial isolates on graphene oxide and their application in methylene blue dye degradation. The synergistic effects of adsorption and biodegradation achieved a unique clean-up performance that the counterpart-free bacteria could not fulfill. Further, toxicity analysis of intermediates also confirmed the non-toxic nature of the intermediates formed after synergistic treatment. This work has the potential to lead to zero effluent treatment processes.

Synergistic degradation of dyes with marine bacteria incubated in graphene oxide matrix

Neha Redkar¹, Madhurima Deb^{1,2}, Manohar Cathrine Sumathi³, Ashok Shivaji Jagtap³, Sumit Saxena^{1,4} and Shobha Shukla^{1,4*}

¹Nanostructures Engineering and Modelling Laboratory, Department of Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay, Mumbai, MH 400076, India.

²Centre for Research in Nano Technology and Science, Indian Institute of Technology Bombay, Mumbai, MH 400076, India.

³Biological Oceanography Division, CSIR-National Institute of Oceanography, Dona Paula, Goa, 403 004, India.

⁴Water Innovation Centre: Technology, Research & Education (WICTRE), Indian Institute of Technology Bombay, Mumbai, MH 400076, India.

Corresponding author email id: **sshukla@iitb.ac.in*

Graphene or graphene-based nanomaterials have emerged as novel scaffolds for developing robust bio-catalytic systems and a fast-developing promising contender for bioremediation. The interaction of bacteria and graphene is such an elusive issue that its implication in environmental biotechnology is unclear. The complexity and recalcitrant nature of the dyes make the conventional techniques inadequate and remain a challenge for industrial effluent treatment. Many scientists have developed hybrid processes and hybrid materials to enhance the treatment processes to satisfy increasingly stringent laws and criteria related to effluent discharge. The current study explicitly focuses on immobilization and growth of dye-degrading marine bacterial isolates on graphene oxide and their application in methylene blue dye degradation. The synergistic effects of adsorption and biodegradation achieved a unique clean-up performance that the counterpart-free bacteria could not fulfill. Further, toxicity analysis of intermediates also confirmed the non-toxic nature of the intermediates formed after synergistic treatment. This work has the potential to lead to zero effluent treatment processes.