

Artificial Photosystems : New Approach to the Synthesis of Boron-Doped Carbon Material from Plastic Wastes for Solar Energy Conversion Applications

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Waste plastics are the major cause of environmental pollution due to low-recycling rates. Herein, I demonstrate the first use of waste plastics as a source of carbon nanoparticles catalysis for artificial-nitrogen fixation cycle. Ammonia is an essential chemical in the N₂ cycle that is widely used in agriculture and clean energy. This research proposes the generalized synthesis method for efficient photo-electrocatalysis for nitrogen reduction reaction (NRR) and azo-dyes photodegradation. The study consists of three experimental setups, as follow: (i) utilize inexpensive source of carbon poly(ethylene) and first liquid-phase thermal reduction of boronic acid, coordinate carboxyl groups at low carbonization temperature on poly(dimethylsiloxane) phase, (ii) I compared visible-light degradation of model dye methylene blue (MB) at 52 different B-doped carbon nanoparticle solutions and poly(ethylene) oxidized species with machine learning (ML) model, evidenced in FTIR, UV-Vis spectrophotometer and SEM/EDS images. (iii) I demonstrate B-doped carbon nanoparticles as an efficient metal-free N₂ reduction photo-electrocatalyst. The B-doped carbon catalyst demonstrates excellent and selective activity at a doping level of 7.3%, and the Faradaic Efficiency (FE) of 8.62% at - 0.5 V vs. reversible hydrogen electrode (RHE) in acidic conditions. Developed functional carbon nano-structures will find many important uses in the future studies, from energy harvesting to monitoring environmental pollutants and energy storage.

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