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Chemistry, a Sustainable Bridge for Energy and Environment from Waste to Materials

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Abstract

The rapid acceleration of climate change and related catastrophic occurrences throughout the planet necessitates extraordinary environmental protection measures. Many nations' policies are now influenced by the United Nations Sustainable Development Goals (SDGs). Adopting the circular economy concept is one of the most important strategies for achieving sustainability. We can no longer afford the infinite accumulation of trash that the linear economic model allows; therefore we should focus on reusing and recycling goods at the end of their useful lives. Because chemistry plays such a large part in the creation of new materials, the shift to sustainability will necessitate more sustainable techniques in chemical synthesis.

Keywords: Sustainable development goals; Organic waste; Waste-precursors; Hydrothermal method

Introduction

The current research subject focuses on the feasibility of creating novel materials using waste-derived precursors for environmental remediation or sustainable energy applications. The overall concept is founded on sustainability ideas, which take into account both the prevention of harm and the production of a benefit. As a result, the usage of waste, which must be eradicated at some expense, may be viewed as a damage containment strategy. Material manufacturing from waste-precursors is seen to be beneficial to society and the economy. When the material is utilized for environmental and energy applications, the benefits are multiplied while the damage is reduced.

The majority of research in this sector still focuses on organic waste, which may be converted into carbon-based materials for use as pollution absorbents or in the formulation of heterogeneous catalysts and electrochemical double-layer capacitors. Through a two-step activation procedure, the lignin portion of pitch pine sawdust was removed and converted into a porous biochar containing graphitic carbon. Through an absorption process that varies with pH, waste-derived carbon was utilized as an adsorbent for the removal of wastewater pharmaceutical contaminants. A hydrothermal method followed by alkaline activation converted bagasse and cluster stalks from winemaking waste into microporous-mesoporous carbon structures. These materials have a high electrochemical double-layer capacitance and are stable enough to be used as negative electrodes in electrochemical energy storage devices. A thorough understanding of the physical-chemical, catalytic properties of activated carbons derived from commercial glycerol, as well as their interactions with reaction reagents and solvents, contributes significantly to the use of biomass-derived carbons to produce platform molecules.

New materials can be made from certain waste-derived precursors by using specific waste characteristics, which are generally connected to the waste precursor's chemical composition or microstructure/morphology. For example, evidence of certain unusual characteristics of porous alumina membranes made from compost-derived bio-based substances, leading in the selective adsorption of cationic sp. The chemical complexity of plant-based biomasses, emphasizing the need for dependable and convergent chemical methods for converting them into platform molecules According to reports, soybean hulls from agro-industrial wastes can still be utilized as adsorbents for inorganic and organic contaminants in wastewater following peroxidase extraction. The adsorption efficiency appears to be highly reliant on the extraction conditions.

There are several prospects for chemical synthesis of materials generated from inorganic waste studies. As a result, we urge the scientific community to expand study in this area, believing that any gain in knowledge in this sector would have a significant influence on society. Consider the following examples: Electric/electronic waste, waste tyres, wastewater, sludges, and other inorganic industrial wastes that are now seldom recycled. A technique for converting inorganic trash into inorganic nanoparticles for use in environmental applications is described in this report. However, while scaling up the synthesis process, toxicological and life-cycle considerations must be taken into account. Extraction of metal cations from industrial inorganic waste and use as inorganic precursors for the synthesis of materials for Zn ash used as a Zn precursor is another method. Another stage will be to directly employ the inorganic waste in the synthesis without any acid/base extraction.

New synthesis procedures will need to be investigated in the future, and greater flexibility will be necessary to maximize the economic and technological advantages of waste-derived material manufacturing. In this regard, Chemistry functions as "a sustainable bridge for energy and the environment from waste to material" must be strengthened in order to make the transfer from concepts to real industrial-social opportunities easier.