Tackling climate change: Carbon capture and utilization via industrial biotechnology.

Wendy Atsumi*

Department of Sustainable Soils and Grassland Systems, Rothamsted Research, Harpenden, Ukraine

Introduction

Climate change is one of the most pressing challenges of our time, with rising carbon dioxide (CO_2) emissions driving global warming and its adverse effects on the planet. As efforts to reduce greenhouse gas emissions intensify, innovative solutions are needed to mitigate the impact of existing CO_2 in the atmosphere. Industrial biotechnology offers a promising avenue through Carbon Capture and Utilization (CCU). This cutting-edge approach not only captures CO_2 from industrial processes but also transforms it into valuable products, presenting a unique opportunity to address climate change while promoting a more sustainable and circular economy. In this article, we explore how industrial biotechnology is spearheading the charge in CCU, revolutionizing the way we tackle climate change.

Understanding carbon capture and utilization

Carbon capture and utilization involve capturing CO_2 emissions from various sources, such as power plants, cement factories, and other industrial facilities, and converting the captured CO_2 into valuable products or useful chemicals. Traditionally, CO_2 capture technologies aimed to store or sequester the captured CO_2 underground to prevent its release into the atmosphere. While carbon sequestration remains an essential strategy, carbon utilization goes a step further by converting CO_2 into products that have economic value, thus incentivizing industries to actively participate in reducing their carbon footprint.

The role of industrial biotechnology in CCU

Industrial biotechnology harnesses the power of microorganisms, enzymes, and other biological agents to perform various tasks and transformations. In the context of CCU, biotechnological processes play a central role in converting CO_2 into valuable products. One of the primary methods involves using microorganisms to convert CO_2 into bio-based compounds through photosynthesis or other metabolic pathways. Additionally, enzymes can catalyze chemical reactions that transform CO_2 into high-value chemicals.

Bio-based materials from CO2

One of the most promising avenues of CCU is the production of bio-based materials using CO_2 as a feedstock. For instance, researchers are exploring the use of algae to capture CO_2 and convert it into biomass. Algae have a remarkable ability to grow rapidly and sequester significant amounts of CO_2 through photosynthesis. The harvested algae biomass can then be transformed into bio-based materials like bioplastics, biofuels, and bio-based chemicals.

Bioenergy and CO2 utilization

Another crucial aspect of CCU through industrial biotechnology is the production of bioenergy. Microorganisms can be genetically engineered to convert CO_2 into biofuels, such as ethanol or biodiesel. These biofuels can serve as a renewable and low-carbon alternative to fossil fuels, contributing to a reduction in greenhouse gas emissions from the transportation sector. Furthermore, some microorganisms can produce biogas, a mixture of methane and carbon dioxide, through anaerobic digestion. This biogas can be utilized as a clean and renewable energy source for various applications, including electricity generation and heating.

Carbon-negative processes: Enhancing CCU impact

Industrial biotechnology holds the potential not only to capture CO_2 but also to turn certain processes carbon-negative. Carbon-negative processes involve removing more CO_2 from the atmosphere than is emitted during the entire production cycle. For instance, in carbon-negative cement production, CO_2 is captured during the cement manufacturing process, and microorganisms are then used to convert the captured CO_2 into biomass or other useful products. This results in a net reduction of CO_2 emissions, making the process carbon-negative.

Mineralization: Turning CO2 into stone

Beyond bio-based materials and bioenergy, another CCU approach involves mineralization, where CO_2 is transformed into solid mineral carbonates. This method mimics natural processes by which CO_2 reacts with certain minerals to form stable carbonates. Scientists are developing technologies that enable accelerated mineralization of CO_2, effectively turning it into stone. These carbonate minerals can be used in construction materials, creating long-lasting and carbon-negative products.

Challenges and opportunities

While CCU via industrial biotechnology presents promising

***Correspondence to**: Wendy Atsumi, Department of Sustainable Soils and Grassland Systems, Rothamsted Research, Harpenden, Herts, Ukraine, Email id: wendyatsumi@gmail.com.

***Received:** 01-Jun-2023, Manuscript No. AAAIB-23-109068; **Editor assigned:** 03-Jun-2023, PreQC No. AAAIB-23-109068(PQ); **Reviewed:** 15-Jun-2023, QC No. AAAIB-23-109068; **Revised:** 20-Jun-2023, Manuscript No. AAAIB-23-109068(R); **Published:** 27-Jun-2023, DOI:10.35841/aaaib-7.3.153*

***Citation:** Atsumi W. Tackling climate change: Carbon capture and utilization via industrial biotechnology. J Arch Ind Biot. 2023;7(3):153*

solutions to climate change, several challenges must be addressed to realize its full potential. Technical hurdles, such as improving the efficiency and scalability of biotechnological processes, remain a priority for researchers. Additionally, economic and policy incentives are essential to encourage industries to adopt CCU technologies. Collaboration between academia, industry, and governments is crucial to facilitate research and development and create a supportive regulatory framework. Public-private partnerships can accelerate the deployment of CCU technologies and foster a conducive environment for innovation.

Conclusion

Carbon Capture and Utilization through industrial biotechnology represents a ground-breaking approach in the fight against climate change. By capturing CO2 emissions and transforming them into valuable products, this approach aligns environmental goals with economic incentives, paving the way for a sustainable and circular economy. As technology advances and global efforts to combat climate change intensify, CCU will play an increasingly significant role in achieving a carbon-neutral future. By leveraging the potential of industrial biotechnology, we have a unique opportunity to turn the challenges of climate change into opportunities for positive transformation and build a greener and more sustainable world for future generations.

References

1. Angers DA, Eriksen-Hamel NS. Full-inversion tillage and organic carbon distribution in soil profiles: A meta-analysis. *Soil Sci Soc Am*. 2008;72(5):1370-4.
2. Baker JM, Ochsner TE, Venterea RT, et al. Tillage and soil carbon sequestration—What do we really know? Agric Ecosyst Environ. 2007;118(1-4):1-5.
3. Bellamy PH, Loveland PJ, Bradley RI, et al. Carbon losses from all soils across England and Wales 1978–2003. Nature. 2005;437(7056):245-8.
4. Cerri, C.E.P., Easter, M., Paustian, K., et al. 2007. Predicted soil organic carbon stocks and changes in the Brazilian Amazon between 2000 and 2030. Agric Ecosyst Environ,122, 58–72.
5. Crutzen PJ, Mosier AR, Smith KA, et al. 2007. N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels. Atmos *Chem Phys*.1:7

Citation: *Atsumi W. Tackling climate change: Carbon capture and utilization via industrial biotechnology. J Arch Ind Biot. 2023;7(3):153*