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Research Scholarship for International Graduate Students



Development of mixed matrix membrane comprising rice husk silica for separating trace gaseous pollutants in biomass gasification process

Wahyu Kamal Setiawan, Kung-Yuh Chiang

Graduate Institute of Environmental Engineering, National Central University, Taiwan

Introduction

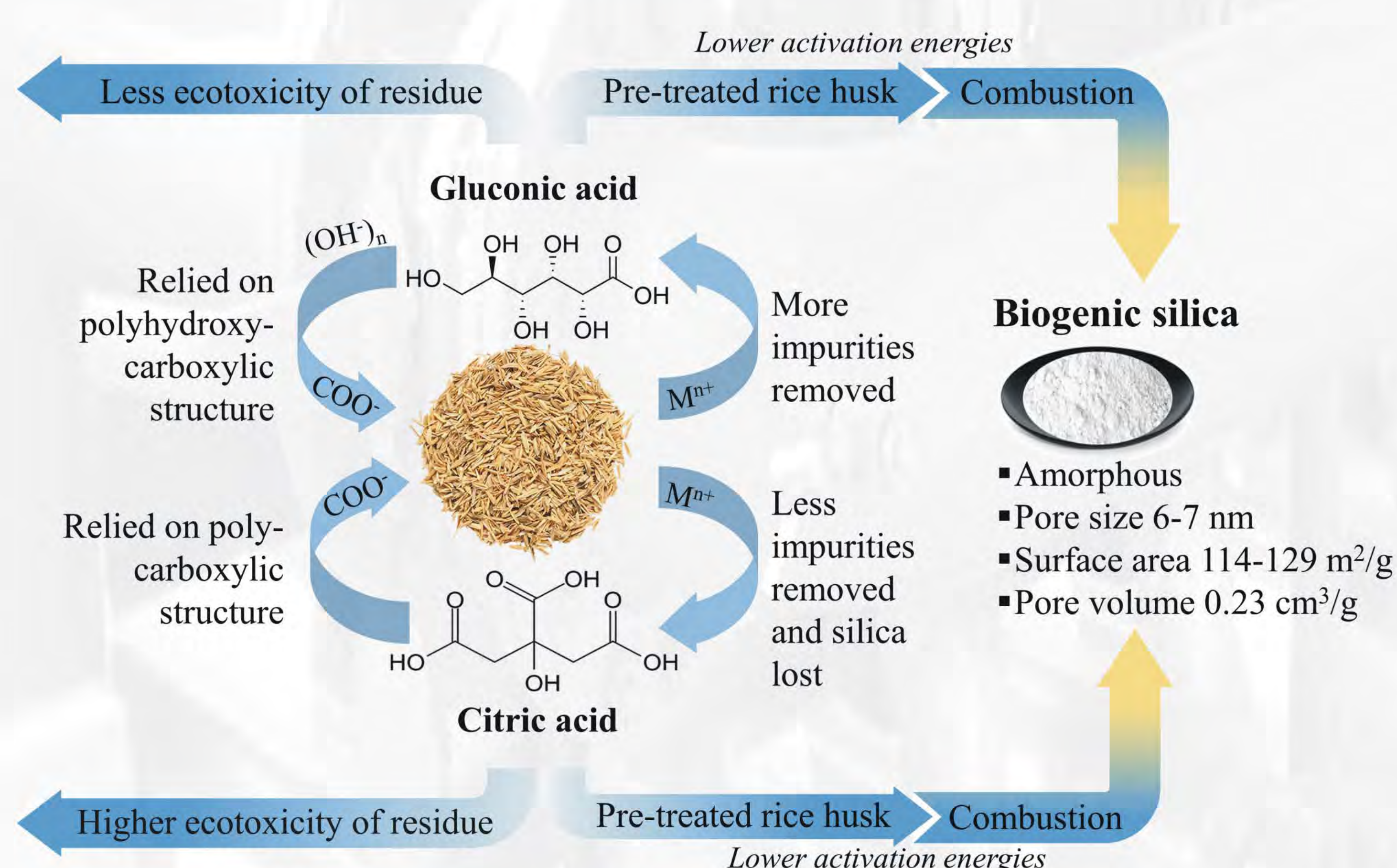
Traditional technologies for acid gas removal generally rely on chemical and physical adsorption or absorption, which are highly efficient but not economically advantageous in installation and energy consumption.

The membrane-based gas separation process becomes a good alternative due to the advantages offered by the process. Mixed matrix membranes (MMMs) can be promoted as an accomplishment to achieve desired gas separation performances.

Research Focus

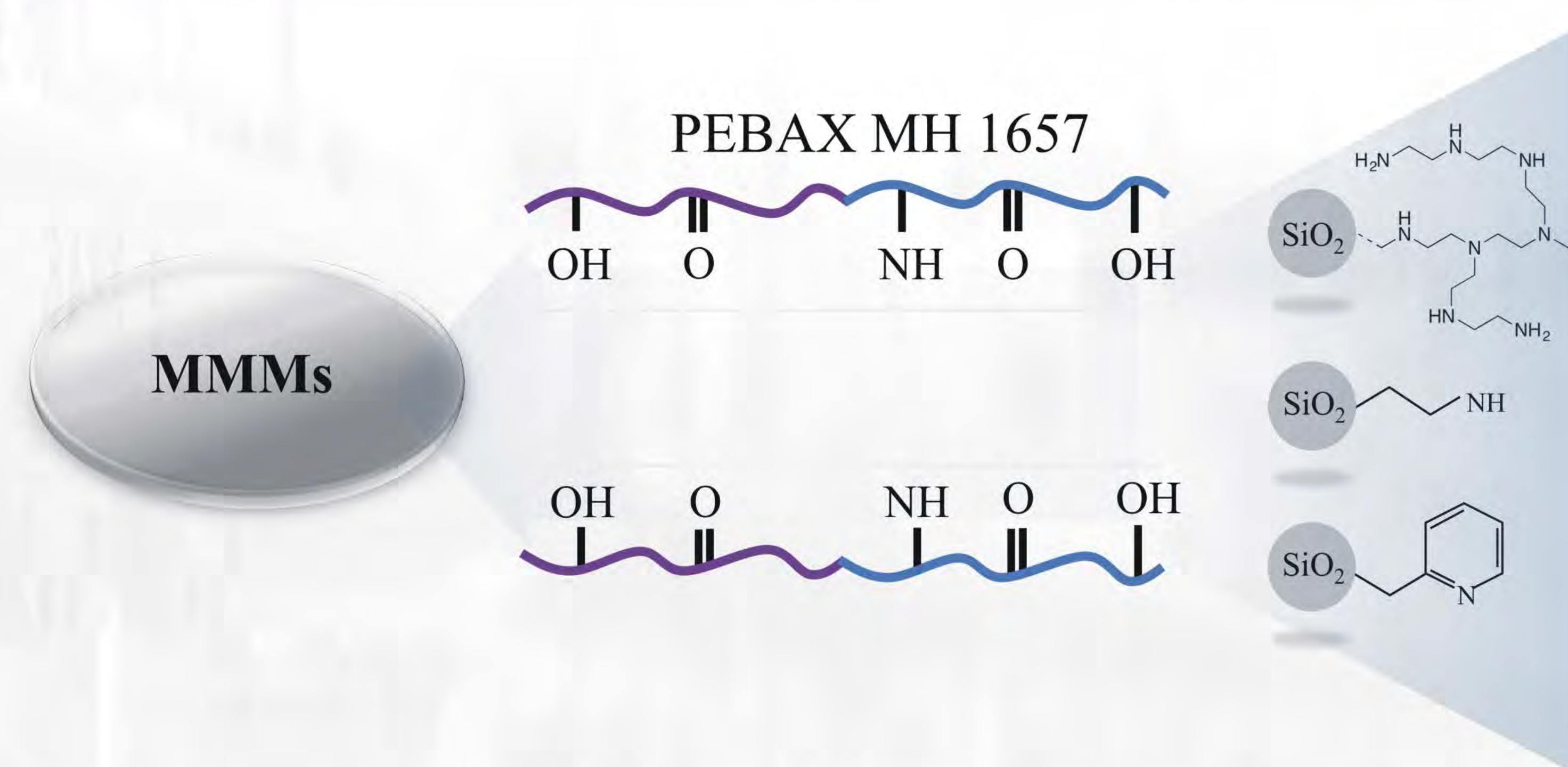
1. Develop a natural based-filler prepared by an eco-friendly recovery process.
2. Produce the MMMs with high-quality properties and excellent gas separation performance.
3. Modulate the MMMs and apply in gasification process for separating trace gaseous pollutant.

Biogenic Silica Recovery



- Gluconic acid (GA) was proposed in rice husk pretreatment for the first time during biogenic silica (BSi) production and compared its performance with citric acid (CA).
- Both GA and CA could produce high purity BSi with identical properties. GA leaching exhibited a minor contribution to all environmental impact categories.
- GA is an excellent and new eco-friendly carboxylic acid for producing BSi from rice husk.

MMMs Fabrication & Characterization



- Pebax 1657 MMMs with three different amine-functionalized silica were successfully prepared.
- Strong interfacial interaction among Pebax 1657 MMMs incorporated amine functionalized silica components as indicated by smaller polymeric chain spacing and high thermal stability.
- MMMs containing polyethyleneimine-functionalized silica exhibited the most remarkable physical and chemical properties.

On-going works

1. Investigate the gas separation performance of Pebax 1657 MMMs: single and mixed gas permeation analysis.
2. Simulate the separation of trace gaseous pollutants of biomass gasification using the MMMs.
3. Modulate the MMMs and apply in lab-scale biomass gasification process.

Recent Publications

1. Setiawan, W.K., Chiang, KY. Silica applied as mixed matrix membrane inorganic filler for gas separation: a review. *Sustain Environ Res* (2021) 29, 32.
2. Setiawan, W.K., Chiang, KY. Crop Residues as Potential Sustainable Precursors for Developing Silica Materials: A Review. *Waste Biomass Valor* (2021) 12, 2207–2236.
3. Setiawan, W.K., Chiang, KY. Eco-friendly rice husk pretreatment for preparing biogenic silica: Gluconic acid and citric acid comparative study. *Chemosphere* (2021) 279, 130541.



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