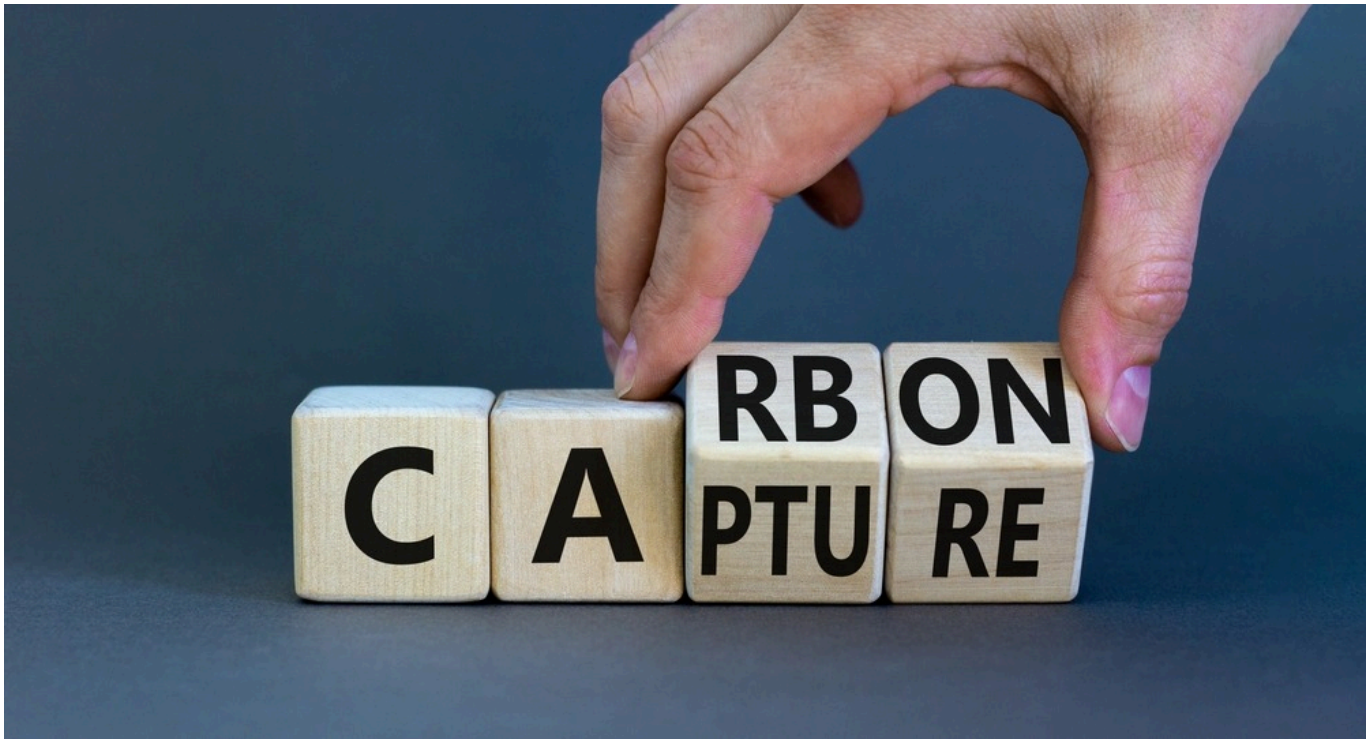
TECH OFFER

Magnesium Oxide Nanomaterial For Carbon Dioxide Capture



KEY INFORMATION

TECHNOLOGY CATEGORY:
Sustainability - Low Carbon Economy

TECHNOLOGY READINESS LEVEL (TRL): TRL3
COUNTRY: SINGAPORE
ID NUMBER: TO174790

OVERVIEW

Pre-combustion, post-combustion and oxyfuel combustion capturing from power plants and other industrial scale companies are the three current carbon dioxide (CO_2) capture and separation technologies. Unlike liquid and membrane adsorbents, solid adsorbents have a wider temperature range of adsorption and can be safely disposed in the environment. The use of solid adsorbents in industrial exhaust gases has shown to be a successful method of trapping concentrated CO_2 for later storage rather than direct emission to the environment. Recent investigations have identified magnesium oxide based (MgO) solid adsorbents as a potential material for CO_2 capture at intermediate temperatures. Furthermore, magnesium (Mg) based minerals are nontoxic, abundant materials which can be prepared in large scale at relatively low cost. Even though MgO has a high theoretical CO_2 capture capacity (1100 mg CO_2/g sorbent), it underperforms in practical applications due to a limiting number of active CO_2 capture sites. MgO reacts with CO_2 to create $MgCO_3$ in dry, high-temperature circumstances. The formation of such $MgCO_3$ carbonates obstructs additional carbon lattice transit leads which lowers the total CO_2 capture efficiency.

This technology offer is an anion doping method of MgO at room temperature to prevent the formation of $MgCO_3$. The novel

$MgO\text{-}Mg(OH)_2$ composite nanomaterial is formed via electrospinning technology and improves the overall efficiency of MgO as a CO_2 capture material.

TECHNOLOGY FEATURES & SPECIFICATIONS

The doping was carried out by electrospinning technology in accordance with thermodynamic and quantum mechanical principles to improve process temperature and dopant/H_2O concentrations in MgO-H2O-MgX (X= $2Cl^-$, SO_4^{2-}, and $2/3PO_4^{3-}$) ternary systems. These novel composites aim to prevent the formation of $MgCO_3$ to unblock the bulk diffusion of CO_2 on MgO sorbents at 30 □ under 1 atm, by using anion anion-doped CO_2-philic MgO and CO_2-phobic $Mg(OH)_2$. This technology can therefore be used as a room temperature CO_2 adsorbents for applications such as indoor CO_2 monitoring sensors.

POTENTIAL APPLICATIONS

This technology can be used for the following applications.

- CO_2 monitoring sensors
- Room temperature direct air CO_2 capture
- Industrial processes where large-scale carbon capture has been demonstrated
- Commercial operation including coal gasification, ethanol production, fertilizer production, natural gas processing, refinery hydrogen production and coal-fired power generation

MARKET TRENDS & OPPORTUNITIES

Persistent atmospheric concentrations of greenhouse gases have now become a global issue, as they have a wide range of direct and indirect consequences on all living things on the planet. The most well-known result of this phenomenon is global warming, caused mainly by growing atmospheric CO_2. CO_2 is a major anthropogenic greenhouse gas, and the National Oceanic and Atmospheric Administration of the United States (NOAA) estimated that the average CO_2 content in the atmosphere would be roughly 416.87 ppm at the end of December 2021, up from 338.80 ppm in 1980. As a result, scientists are actively developing solutions to minimize CO_2 levels in the atmosphere.

The global carbon capture and storage market size was USD 2,784 million in 2021 and is estimated to grow at a CAGR of 13.7% from 2022 to 2030 and reach USD 8,636 million by 2030. The key markets drivers are:

1. The surging investment to develop new capturing facilities
2. The increase in government initiatives to achieve net-zero emission rates in the future

UNIQUE VALUE PROPOSITION

This technology addresses the limitation of MgO-based solid adsorbents and has the following advantages:

- Better carbon capture efficiency
- Cheaper than current CO_2 adsorbent material

The technology owner is looking for partners for R&D collaborations especially those who are interested in carbon capture materials such as power plants or CO_2 monitoring systems. The owner is also keen to license this technology as well.

IPI SINGAPORE Innovation Partner for Impact

For more information, contact techscout@ipi-singapore.org