

Carbon Capture through Ga-based Liquid Metal Alloys

Graduate



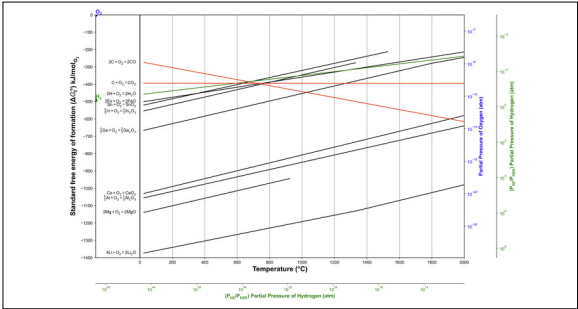
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Introduction: To reduce greenhouse gas emissions, fossil fuels need to be replaced by renewable energy sources. Carbon capture storage (CCS) is a negative emissions technology that can offset these emissions. CCS involves the capture of CO₂ from various sources and its subsequent storage. Four main methods of carbon capture are possible: post-combustion, pre-combustion, oxyfuel, and chemical looping. The impact of CCS is expected to increase in the future to achieve net-negative CO₂ emissions by the second half of the century.

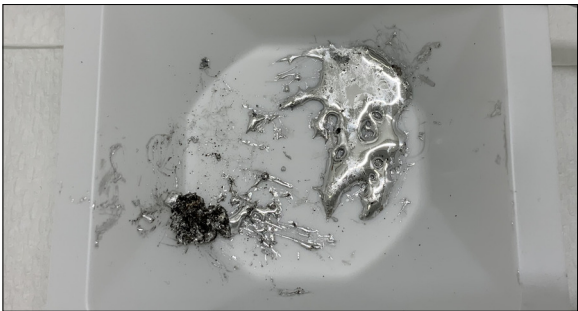
Approach / Technology: Gallium-based liquid metals have demonstrated the potential to reduce CO₂ into solid carbon. This study investigates the potential of different gallium-based liquid metal alloys for carbon capture. The reaction is conducted in a bubble reactor containing a metal alloy that is liquid at room temperature. Argon and CO₂ bubble through the reactor before the gas is analysed using a mass spectrometer (MS). The research focuses on the influence of doping materials on the CO₂ conversion efficiency and the characterization of reaction products. Additionally, the test setup was adapted to accommodate the new reactor design. Iron and aluminum were selected for alloying and testing. The samples were prepared by alloying 8 ml of eGaInSn with 3 wt% of each material. The alloying process and entire testing procedure were carried out in an inert environment to prevent the oxidation of the samples.

Result: Gas analysis did not show a clear trend of increased CO₂ conversion at higher temperatures for all samples tested. After the gas analysis, long-term testing was performed by running CO₂ through the reactor to form reaction products. Scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM/EDX) analysis confirmed the successful alloying of the samples and indicated the presence of carbon in the reaction products of all samples. This proves the CO₂ decomposition inside the reactor.

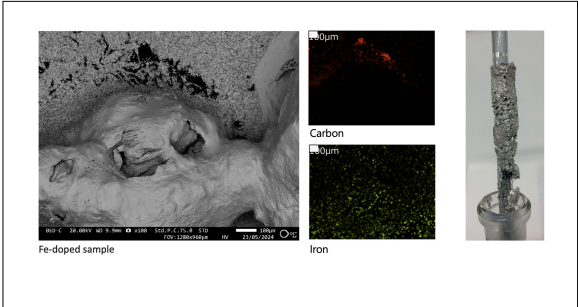
Ellingham diagram of selected metals and oxides. Own presentation



Initial testing with eGaInSn. Own presentation



SEM/EDX analysis (left) and reaction products (right) of the iron-doped sample. Own presentation



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Subject Area

General environmental technology