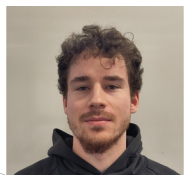
Carbon capture with liquid metal

Student



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Introduction: Climate change is one of the greatest challenges of our time. Among other greenhouse gases, the emission of carbon dioxide, which is mainly related to the use of fossil fuels, is the biggest driver of global warming. In June 2023, the Swiss electorate approved the Climate and Innovation Act by popular vote. This sets a target of net zero greenhouse gas emissions by 2050. It further stipulates subsidies for innovative technologies amounting to a maximum of 200 million Swiss francs over six years. The law also defines negative emission technologies, which are biological and technical processes for removing CO2 from the atmosphere and its permanent binding in forests, soils, wood products or other carbon reservoirs. The umbrella term for such processes is Carbon Capture and Storage (CCS), this study paper deals with one such process.

Definition of Task: The work includes the following tasks:
1. preparation of a risk analysis
2. detection of solid carbon as reaction product
3. evaluation of the reaction conditions
4. optimization of the reactor

The aims of the work are
1. proof of reaction
2. determination of optimal reaction parameters
3. new reactor design

Conclusion: EDX and MS have demonstrated the reaction of CO2 to solid carbon. The conversion rates of about 1.5 % are still very low compared to conventional processes. In order to achieve higher conversion rates in the future, the process can be further optimized by preventing tunnel formation from decomposition products. Another open question is whether the quality of the LM reactant decreases over time. Long-term measurements are required to verify this. Tests regarding the loss of conversion at temperatures over 320°C can be performed in future. Comparisons between test under similar conditions point to stability issues that need to be addressed in future. Reproducible reaction conditions must be created in order to evaluate the optimum reaction conditions. This is partially achieved with the new reactor design, but the quality of the LM must also be guaranteed. Tests should also be carried out in lower temperature ranges. Lower volume flows should also be possible with the new controls. The problem of tunnel formation could not be solved with the new design, the proposed solutions in the execution of the tests should fix it. Proof with the TGA may still be possible in future if the quality of the powder product improves in terms of purity and carbon content. The new reactor is to be set up and tested. The processing of the reaction product with sulphuric acid is to be pursued further in order to achieve better separation of products leading to recovery of pure C.

Overview of various CCU or CCS procedures
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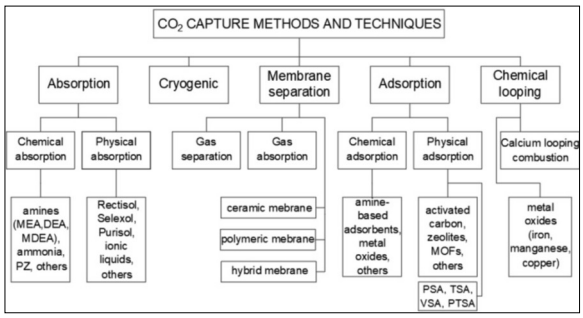
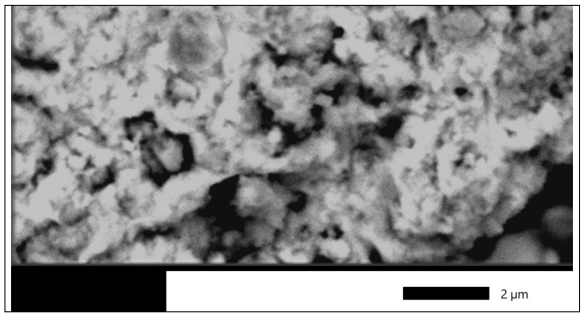


solid reaction product
Own presentment

SEM image of reaction product
Own presentment



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Subject Area
Air pollution control, General environmental technology