CO_2 Capture Using Heterocyclic Molecules

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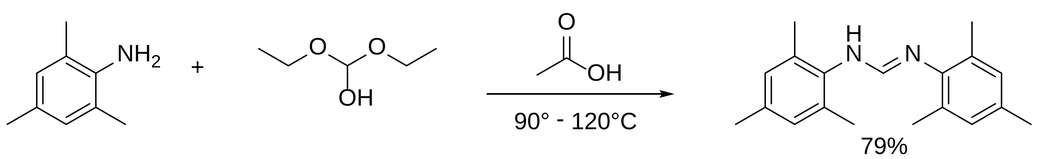
Introduction

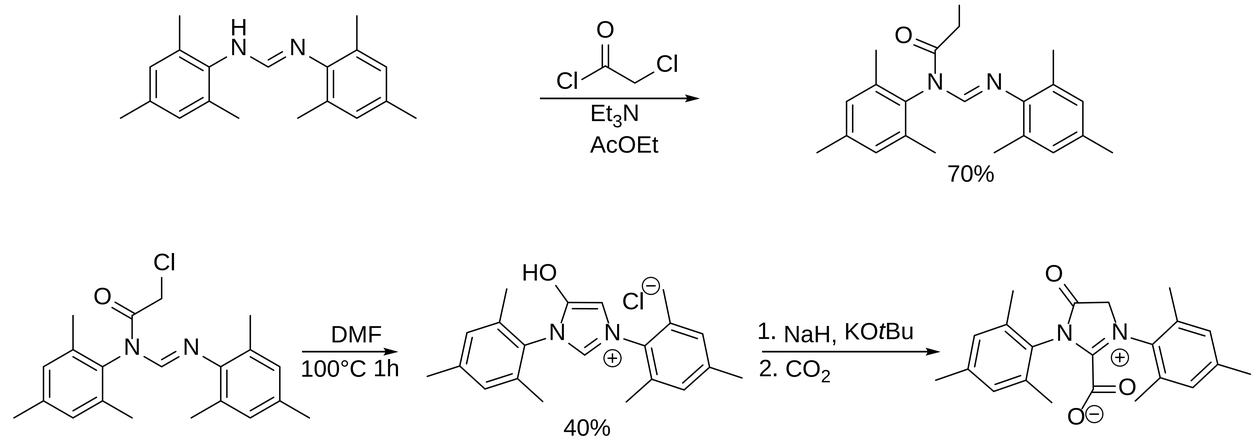
With the increase in global warming caused by the release of greenhouse gases, finding a way of capturing CO_2 before the gas reaches the atmosphere has become an important topic in scientific research. This experiment attempts to design a heterocyclic carbene that will capture industrial CO_2 emissions.

Project Overview

For a starting material we used N, N'-dimesitylformamidine (made by combining mesitylamine and triethylorthoformate). This molecule was subjected to two separate, multi-step procedures which resulted in a heterocyclic compound with an alcohol group attached and a heterocyclic compound with a silyl group attached. These two molecules were then exposed to CO_2 and the results were analyzed using proton NMR.

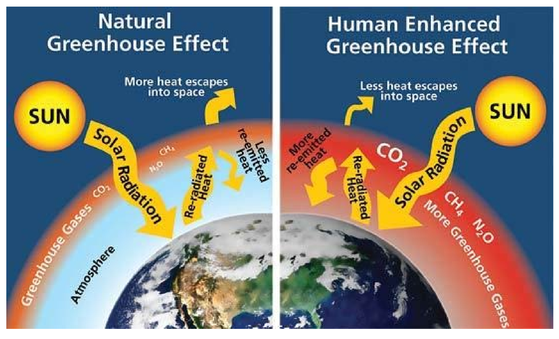
Experimental Procedure





High School Focus

It is known that carbon dioxide gas present in the upper atmosphere traps heat and thus acts like a global blanket. The sun warms the surface of the Earth and the heat normally radiates back out into space. Because CO_2 (gas) at some level is naturally present in the Earth's atmosphere, a certain amount of this blanket effect is normal. However, the widespread combustion of fossil fuels in our modern world has produced vast quantities of carbon dioxide gas, thus thickening the blanket. Much of the heat energy ends up trapped in our atmosphere. In the past century, the amount of carbon dioxide in our atmosphere has increased to the point where scientists are concerned that our planet is slowly warming up. This phenomenon is called the greenhouse effect and is associated with global warming.



High School Lab Experiment

Experimentally students will produce CO_2 gas using HCl and sodium bicarbonate. Once produced, the gas will be analyzed for mass, volume, pH, combustibility, and finally the gas will be neutralized (captured) using NaOH.

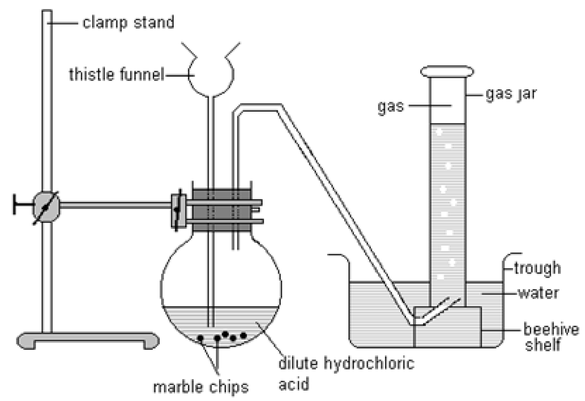
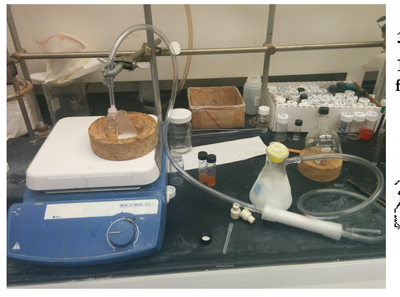
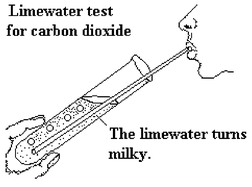


Diagram of Apparatus





Conclusion

This project produced two new molecules which were both able to capture CO_2. For the molecules to be used for large scale carbon capture, there needs to be a carbene formed between the two nitrogen atoms. The research is ongoing to find the optimum conditions to produce the carbene. This project will be a good reference for myself and my students to use when we conduct lab experiments to produce and analyze CO_2 gas.

Acknowledgements

Dr. Aditi Chavannavar – Thank you for patiently answering my endless questions, and for keeping an eye on me so that I didn't set myself or the lab on fire.

Ashfeld Group – Thank you for letting me see the potential of teaching. I hope that my students will someday achieve the same high level of scientific competence and knowledge that all of you so obviously possess.

http://i.livescience.com/images/i/000/053/475/i02/Greenhouse-effect.jpg?1370382117