Benzimidazoles and How to Synthesize Them

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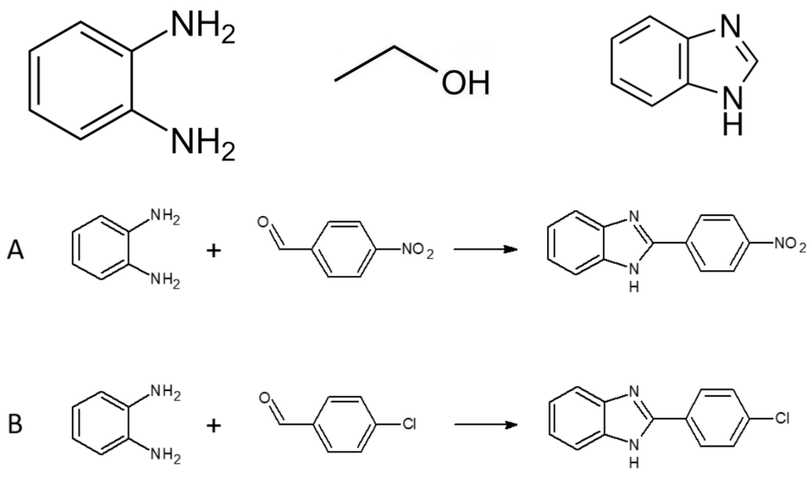
Introduction

The concept of green chemistry has been playing an important role in recent years for meeting the fundamental scientific challenges of protecting the living environment. One of the thrust areas for achieving this target is to explore alternative reaction conditions and reaction media to accomplish the desired chemical transformation with almost negligible by-products and waste generation as well as elimination of the use of volatile and toxic organic solvents. The goal is to identify simple, effective syntheses of valuable substances using green chemistry techniques and materials. Molecules with benzimidazole moieties are attractive targets for synthesis since they often exhibit diverse and important biological properties.

Reactions



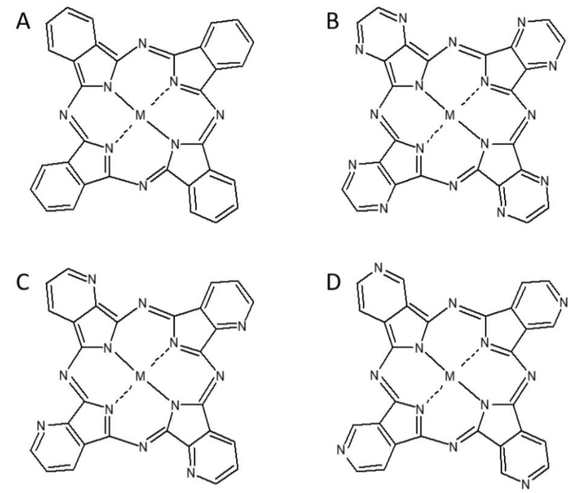
Methods and Processes

Due to their widespread use in different engineering applications, considerable efforts have been paid to develop efficient methods for the preparation of benzimidazole derivatives. Some of the common methods involve condensation of o-phenylenediamine with carbonyl-containing compounds, such as aldehydes, carboxylic acid, and acid halides, in the presence of various catalysts and hazardous solvents.

In my experiment, the phenylenediamine was dissolved into ethanol and boiled. Then Co-phthalocyanine and 4-methxybenzaldehyde were added to solution. The solution boiled for one hour. The Co-phthalocyanine was recovered by filtration. The filtered solution reacted with cold water to form a precipitate. The benzimidazole derivative was then filtered. Results were analyzed via infrared spectroscopy.

Catalysts

Catalysts change the mechanism of the reaction by altering the reaction energy needed to start the reaction. By heating the solution and adding the phthalocyanine we decreased the reaction time by two hours. In the picture on the left we used the metal phthalocyanine labeled A with a cobalt center. In future work will use different transition metals at the center of the phthalocyanine to determine which will optimize yields.



Conclusions

While time in the laboratory was cut short due to uncontrollable circumstances, we were able to replicate the literature method. Given the wide range 2-phenylbenzimidazole range of compounds, their use as reagents in the synthesis of related pharmaceutical compounds, and their potential importance in the direct development of pharmaceuticals, effective and rapid methods of synthesis such as the one demonstrated in this work should be developed and refined. Benzimidazoles have been synthesized by a number of methods and using a variety of starting material.

With further experimentation, we are hopeful that we can effectively determine what the best catalyst would be. Future experiments would use pyridinoporphyrazines and pyrazinoporphyrazines as catalysts.

References and Further Reading

Voegel, Phillip, and Charles Genovese. “Catalytic Synthesis of Substituted Benzimidazoles Using Transition Metal Phthalocyanines, Pyridinoporphyrazines, and Pyrazinoporphyrazines.” 2010.

Acknowledgements

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