Precise, Green and Safer Heating for Nano Material Synthesis towards Renewable Energy

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Awarded: $4225.12, Spent: $4173.23

Description: Our laboratory synthesizes materials for renewable energy applications, requiring precise temperature control, extended heating durations, and temperatures exceeding 100°C. The conventional method for heating above 100°C typically involves using a silicone oil bath. This approach generates substantial waste and poses environmental hazards due to the difficulty of reusing the oil. Temperature controllers and heating mantles can effectively address these issues. These devices do not require significant amounts of water for cleaning and maintenance and offer extended operational lifespans with proper care. Our project aims to transit to a greener alternative for daily research by equipping each workstation in our lab with temperature controllers and heating mantles, in order to reduce our environmental footprint and foster a more sustainable approach to conducting high-temperature experiments.

Objective: Use temperature controllers and heating mantles instead of silicon oil baths to ensure sustainable and precise heating for experiments.

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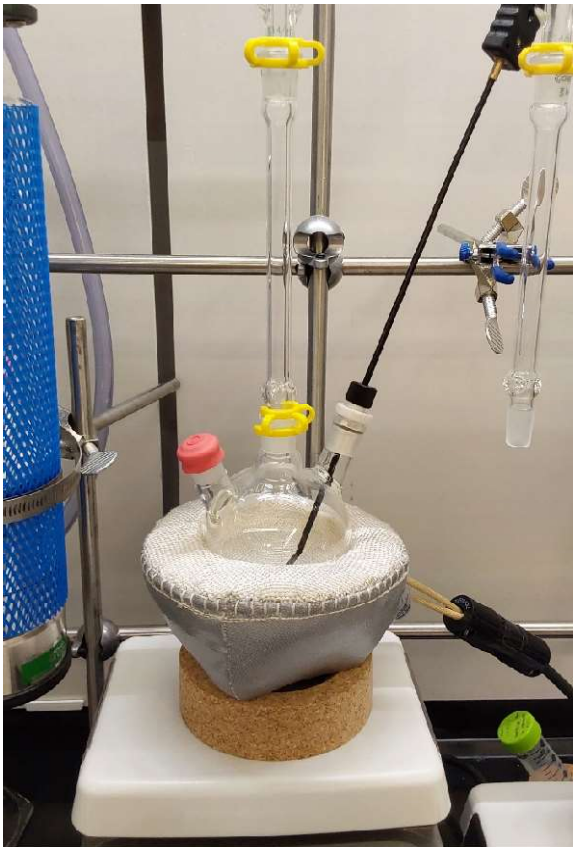
Results: After thorough research and discussions, we acquired three temperature controllers from Chemglass, along with two 50 ml and two 100 ml heating mantles from VWR. This investment facilitated the routine use of these heating devices over silicone oil baths, resulting in reduced energy consumption in our lab. We identified a few key additional takeaways from this project:

1. **Temperature controllers and heating mantles offer safe heating.** Oil baths can cause serious splattering with accidental additions of water to oil, posing significant safety risks and potentially compromising the experiment due to slippery reaction flasks. **In contrast, temperature controllers and heating mantles are less prone to safety hazards. They are also easier to assemble and disassemble than oil baths, reducing setup and cleanup time.** As a result, students in the lab are less exposed to the risk of burns and fire when injecting reagents into flasks during heating. **This enhanced safety promotes a more secure and efficient laboratory environment, enabling safer and more reliable experimental procedures.** See example picture (1)
2. **Temperature controllers and heating mantles enable efficient experiments.** Oil baths occupy substantial space and present high safety risks due to potential spills. **On the contrary, a temperature controller and heating mantle set requires minimal space, providing more workspace for operation and allowing multiple experiments at different temperatures to be conducted simultaneously.** Furthermore, we can wrap the

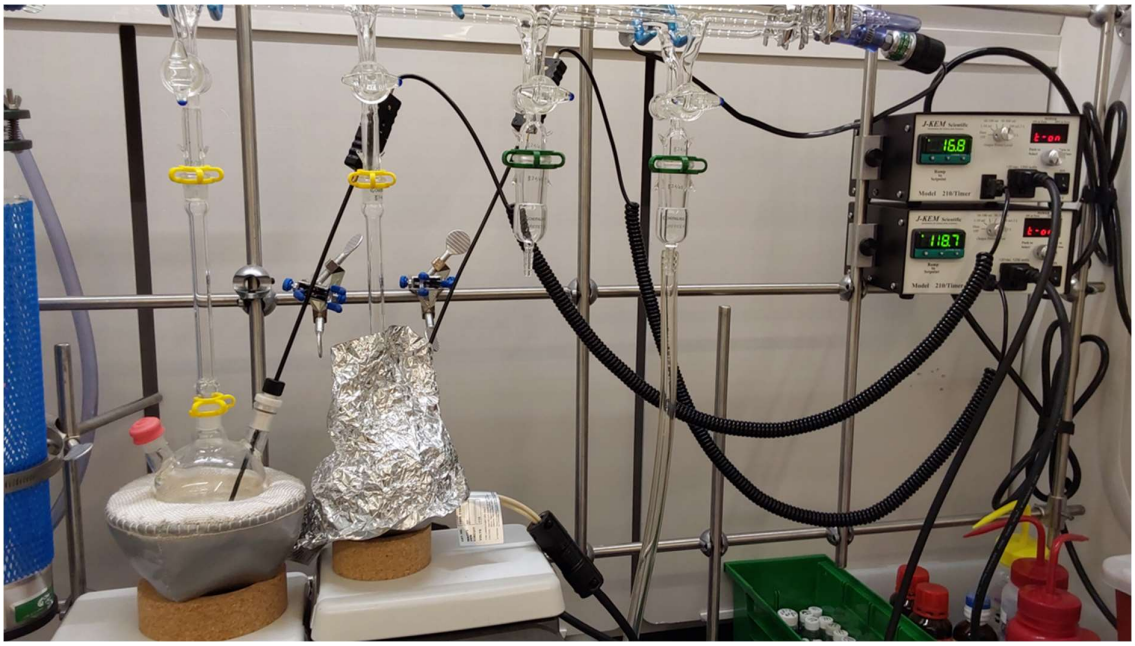
reaction flask with aluminum foil to ensure even and continuous heating in the fume hoods, undisturbed by constant airflow. **This arrangement enhances the productivity and safety of the experiments, facilitating a more organized laboratory environment.** See example picture (2)

3. **Temperature controllers and heating mantles facilitates experiments in wide range of scale.** During the preliminary and optimization stages of an experiment, minimizing the scale of test runs is desirable. **The set of temperature controller and heating mantle substantially reduces the use of radiative and toxic reagents, such as cesium and lead, thereby reducing environmental stress. Additionally, it decreases the cost of reactions by conserving solvents and other reagents.** This improvement not only aligns with our commitment to sustainable practices but also enhances the overall efficiency and safety of our laboratory operations. **By reducing reagent use and minimizing waste, we contribute to a more environmentally friendly research environment while maintaining high experimental standards.**

Related Media



(1) Safe and precise high temperature heating for perovskite quantum dot synthesis without the use of oil.



(2) Efficient heating for multiple reactions at different scale and temperatures simultaneously.