Flow Chemistry? Do It Yourself!

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Abstract

We constructed a continuous-flow system with available materials in order to help teaching flow chemistry in universities.

Introduction

Chemical reactions apparatus have evolved from simple flasks to fully automated systems. This evolution led to use continuous-flow systems, which can be more versatile than batch processes[1] and reaction parameters can be better controlled. In addition, continuous-flow reactions are in compliance with several principles of green chemistry.[2] On the other hand, due to high cost and instrumental complexity of flow chemistry, teaching it is still a challenge. However, anyone can build their own equipment with a significant cost reduction[3] and a better understanding of the process. In this context, we report here the construction of a low-cost, open hardware and open code continuous-flow system to allow a broad use for teaching and researching.

Results and Discussion

Our continuous-flow system is composed by a homemade syringe pump and a reactor in a heating block with temperature control (Figure 1).

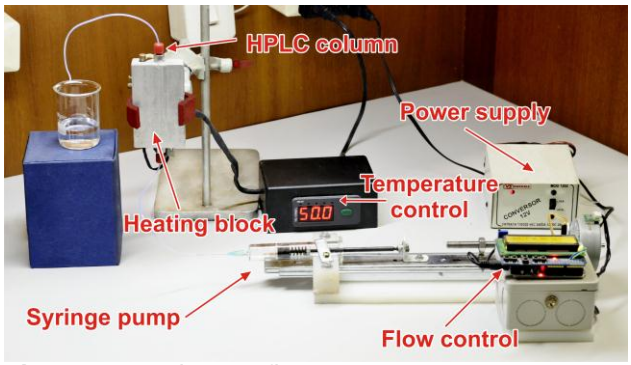

Figure 1. Continuous-flow system.

The syringe pump was constructed with a drawer slide, fixed on a polyoxymethylene polymer base and connected to a stainless screw through a screw nut, which provided movement transfer. This apparatus was connected to a step motor from an old deskjet printer, and to a power drive controlled by an Arduino Uno R3 microcontroller (Figure 2 - A). A LCD keypad display shield and direction keys were used to allow changes in volume of solution to be added. The syringe was connected to the reactor via a Teflon cannula.

We used an empty HPLC column (100 x 4.6 mm) as reactor and we also constructed a heating block (8.5 x 5.0 x 2.0 cm) for temperature control (Figure 2 - B). The heating block was a piece of aluminum with two holes: one for the column and other where a heating element was fixed. The heating block was controlled by a commercial thermostat.

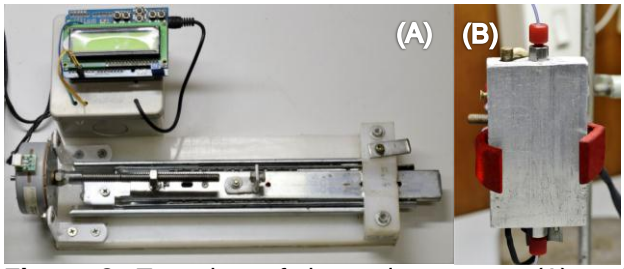

Figure 2. Top view of the syringe pump (A) and heating block (B).

The total cost of the system was under US$ 70,00 and also promoted recycling of some “electronic trash”.

Easy experiments involving heterogeneous catalysis can be performed using our continuous-flow system, being a tool for teaching and understanding flow chemistry.

Conclusion

A low cost homemade continuous-flow system was successfully built, composed by inexpensive and easily available materials. The system can be used to perform easy experiments, helping to teach flow chemistry in school and universities.

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