Development of Multi-sensor Paper-Based Test Kit for Heavy Metal Detection

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The contamination of heavy metal ions in water sources can adversely affect the environment. Existing detection methods are impractical and inaccessible for field testing due to monetary cost and other requirements. In this project, we aim to make testing more widely available and practical by developing a new low-cost multi-sensor paper-based test kit. Firstly, we identified the best three-way paper-based template for making test kits. Several organic sensors were then synthesized, characterized, and loaded along the template. Multiple tests were carried out to establish capable sensors for further development into a test kit. Based on the results, 3 rhodamine-derivative sensors, with high purity, were chosen for our paper-based test kit because of their distinct changes of color. The three sensors were loaded on the templates and were then tested for sensitivity, selectivity and interference. The results showed that all three sensors have good selectivity, and interference effect conditions. Moreover, the distance of the color bands can be used to calculate the concentration of heavy metal ions in a water sample by using pre-constructed concentration-distance tables which were derived from our calibration curves. Finally, we used these results to develop a test kit prototype which was then tested with water collected from the field. In conclusion, we have designed a multi-sensor test kit which is a paper template loaded with three organic sensors: Rhpz, Rh6GCA, and RGETU for detection of Co(II), Fe(III), and Hg(II) ions, respectively. This prototype can be developed further for use in the agricultural sector and other sectors for field testing of heavy metal contamination at low cost and in a very short period of time.

Awards Won:
Second Award of $2,000