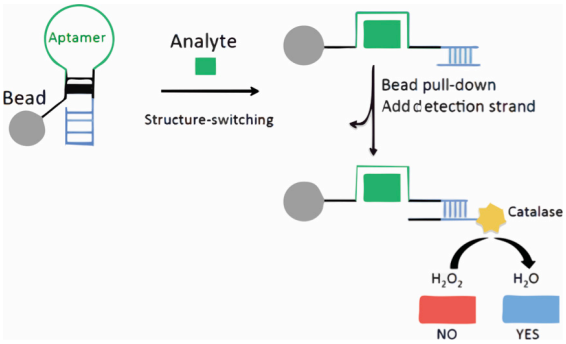
Development of a low-cost water monitoring kit for multiplex heavy metal detection based on aptamer sensors

With the growth of human population, industrialisation and urbanisation, the demand for safe drinking water continues to increase, and along with it, the problem of water pollution has become a concern. It is estimated that contaminated water causes 30,000 deaths around the world every day. Among the toxic contaminants released to our drinking water are non-persistent materials such as oil, grease, ammonia and sulphur compounds, which break down into less harmless by-products; and persistent compounds that are readily absorbed by living animals including human. These compounds include hydrocarbons, chlorinated compounds and heavy metals. This project targets specifically a priority area for the IC-IMPACT Water for Health collaborative research project: Heavy metals identification using biosensors.



Our group at the NanoBios Lab, IIT Bombay along with researchers from the Micro & Nano Bioengineering Lab, McGill University, Canada aim to develop a novel detection technology that is suitable for routine water monitoring at low-resource setting. This detection system would integrate a simple analyte detection mechanism based on micro beads for finding concentration of toxic analytes from large volume water samples. The recognition of target analytes is based on structure switching DNA aptamer, which would in yield a signal that, could be read easily without the need for any special equipment.

The outcome of the project will be a low-cost, small, easy-to-use water monitoring kit capable of highly sensitive heavy metal detection. The low-cost would eliminate financial barriers for widespread deployment and adoption by users in poor areas. The ease-of-use and clear result read-out would encourage routine and reliable testing. The water monitoring kit is supposed to offer tangible benefits to users; particularly those rely on ground water of questionable quality as their drinking water to ensure their safety and well-being.

Micro & Nano Bioengineering Lab, McGill University, Canada is working on the structure switching DNA aptamer chemistry and developing a multiplexing technique to quantify toxic analytes; while our group is working on microbeads for attaching the detection mechanism to analyse large volumes of water effectively. We would also work on the detection instrument development for the same. Both the teams would design the final kit collaboratively. A biosensor scheme, based on structure switching aptamers has already been tested.

Traditional quantitative methods such as atomic absorption/emission spectroscopy, cold vapor atomic fluorescence spectrometry and inductively coupled plasma mass spectrometry can detect heavy metal ions with high sensitivity. Despite their high sensitivity, these techniques require expensive and complex instrumentation, and involve cumbersome chemical processes required to extract the metal analyte from the water samples. Our biosensor-based approach would be easy to use, affordable and readily available for use in low resource settings.

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