Applications of molecularly imprinted polymers to mineral exploration and mineral processing

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Molecularly Imprinted Polymers (MIPs) are “smart plastics” developed to recognize and selectively uptake a variety of target materials from either a liquid or a dissolved solid. The MIPs are initially created in the presence of a specific target material which is subsequently removed to leave a complementary cavity behind. This cavity is able to recognize and bind the same target material from a range of matrices, with wide applications in filtration and sensing.

MIP systems developed to date have successfully been used in industry, and have broad applications to field and lab-based exploration geochemistry, and filtration of unwanted materials or high value components is needed, such as removing high value or economically sensitive elements from geothermal fluids (e.g., Au, Ag, and As) or during mineral processing.

MIPs can capture a significant amount of material from a wide range of matrices, even at part per billion concentrations. The polymers are re-usable, making them a cost effective technology with the potential to provide affordable solutions to complex problems. This means that MIPs have potentially broad applications to mineral processing, whereby they can be used to target and remove various dissolved elements of economic or environmental interest during mineral processing. The technology can also be used to supersede existing filtration methods in both cost and efficacy, making them not only suitable for new target materials but potentially beneficial in upgrading older filtration systems. In some cases multiple polymers can be combined to target more than one compound of interest at a time, opening up the possibility to harvest multiple elements from a single mineral processing process, both adding value and reducing economic risk from having a single-commodity mining operation.

As an example, we have proven the technology to work in an agricultural industrial application by removing nickel from magnesium ore. Developing a polymer and process that can remove the excess nickel from the ore has enabled the commercial partner to have the ability to opt out of their current magnesium ore source and source the magnesium ore from a local quarry. The nickel that is removed can be used in stainless steel production, enable the production of cheaper fertilizers and animal feed in addition to creating value for a locally sourced material.

Other metals of interest in detection and removal have comprised a suite of trace elements (In, Ga, Ge) from geothermal waters, and chromium from waste water. A suite of other metals (Cd, Au, Cu, Fe) have been imprinted and the polymers tested against real samples to prove their ability to uptake the target elements.

The technology also has applications in mineral exploration, as it can potentially be used as a detector to evaluate the presence/absence and concentration of a range of metals from a variety of
matrices (water, soil, rock). This has direct application to mineral exploration, whereby gold and other metals (e.g., Cu and Ni) could potentially be detected to part per billion levels in the field.