



Chemical Breakthrough

A young researcher discovers a way of assembling inorganic molecules

Quesnel, British Columbia, for those who don't know, lies in the centre of the province, about 600 km northeast of Vancouver. This town of 8,300 people is known for its logging, not as a breeding ground for new materials chemists. Not until this year, anyway. That was before Quesnel (pronounced Quen-nel) native Mark MacLachlan, a doctoral student in the University of Toronto's Department of Chemistry, published a paper in the prestigious journal *Nature* unveiling a new, metal-like substance that someday might be used on everything from removing pollution to sniffing out dangerous gases in mine shafts. He shared credit for the paper with Geoffrey Ozin and microscopist Neil Coombs but according to Ozin the promising new kind of microporous material they have created -- known as a germanium sulphide mesostructure -- would not have been possible without MacLachlan's insight.

Ozin is well known for his work on using chemical methods to assemble molecules into more complex structures. He says materials chemistry is a burgeoning field right now: chemists are expanding beyond their traditional field of assembling molecules into using those molecules as building blocks in multimolecular structures of greater and greater complexity. Using molecules as building blocks is nothing new to organic chemists: it's how everything up to the bones in our own bodies is "assembled."

But materials chemists like Ozin are still learning how to use chemistry to "assemble the inorganic." "We are just beginning to approach the complexity of hard materials in the natural world with these new supramolecular materials," he explains. To better understand what the team has created, think of a honeycomb, with its hexagonal spaces constructed of beeswax walls. Now imagine that same kind of highly organized structure but with walls of germanium sulphide one molecule thick and hexagonal spaces up to 500 angstroms across (an angstrom is one ten-thousandth of a millimetre). Instead of a solid wall of sulphide molecules you have something that could be a sieve or a net. Because the metal sulphide clusters are electrically conductive, the new structure could be modified to detect other molecules passing through the holes in the net, making it a chemical sensor, of sorts. "We thought it might be useful for detecting odours because it can respond electrically. Or it could be used to trap heavy metal molecules, to remove pollution from a river, for instance," says MacLachlan. Other uses, if any, will become apparent over time. What the scientists are celebrating right now is finding out how to construct such a material. Their difficulty was that sulphide clusters have to be dissolved to assemble and these sulphide clusters do not dissolve in water. The chemists had to find a different solvent to make the structure work.

It was MacLachlan who hit upon using formamide, a relatively obscure liquid. "When we used formamide, the clusters just snapped together," says MacLachlan. The assembly process uses formamide and a surfactant, something like dish soap. Instead of spherical soap bubbles (or micelles, in chemistry terms), this surfactant forms cylindrical micelles: the sulphide clusters assemble in the spaces in between. Remove the surfactant and you are left with a germanium sulphide honeycomb. MacLachlan, now finishing his PhD after doing his undergraduate studies at The University of British Columbia, is trying not to let the excitement of his first *Nature* paper at the age of 25 go to his head. "I came to the University of Toronto because I find this whole field fascinating." The young scientist is actually the first in his family to earn a university degree -his family works in the logging industry in Quesnel. Now, besieged by reporters from across Canada, he is also proving remarkably good at explaining his work in terms the general public can understand. One favourite analogy involves comparing his process to casting logs in concrete, then burning out the logs to leave a concrete structure behind. Sounds like something a guy from Quesnel would say, doesn't it?