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TRIUMF Participates in Malaria Research

Malaria has been a long-time antagonist of tropical human populations, most commonly in sub-Saharan Africa. The disease, transmitted via mosquitoes that carry infected protozoa from host to host, causes fever, shivering, vomiting, and anemia leading to coma and death if left untreated. The prohibitive costs of mosquito nets and DDT sprays in some developing countries may be responsible for 300 – 500 million new cases reported annually, resulting in up to 2.7 million deaths per annum.

Dr. Mike Adam (TRIUMF)

Dr. Chris Orvig (UBC Chemistry Department)

Drug resistance continues to be a threat in the treatment of those infected with the most aggressive malaria parasite, *Plasmodium falciparum*. Although several drugs were, at one time, effective at killing the harmful organisms, the continually evolving protozoa have "learnt" how to combat pharmacological agents. No vaccines are commercially available yet for the prevention of malaria; however, there is active research and at least one Phase II drug being developed by the pharmaceutical industry.

Research is underway that shows promise for a new generation of drugs, such as a study led by **TRIUMF**'s Dr. Mike Adam and the University of British Columbia's (UBC) Dr. Chris Orvig. Their original focus was to make sugar-radiometal conjugates for medical imaging purposes; but after manufacturing sugar-ferrocene compounds, these two researchers decided to send samples to colleagues at other institutions to test for anti-malarial effectiveness. By taking older, less effective drugs and adding a new chemical group (in this case, a ferrocene group, which is known for its possibilities in the anti-malaria field of pharmacology), they have increased the effectiveness of the older drugs while retaining relatively low toxicity levels for the host. The ferrocene molecule, an organometallic compound, has long been known to have many derivatives with a variety of desirable properties in research. Specifically, parasite death is provoked by causing an accumulation of anti-malarial material in the parasite's food storage centre (the vacuole), such that the volume is too much for the parasite's system to handle.

The research explored in the paper co-authored by Drs. Adam and Orvig mentions that the compounds studied did not display extraordinary ability to inhibit infection; however, this method of conjugated compounds is promising for focusing on cytotoxicity (chemicals being toxic directly to cells), and anti-plasmodial effectiveness (ability to cause plasmodium death) may emerge as a compelling means of drug development in the future.

TRIUMF was an integral player in this inter-institutional research project, which had collaborators from Canada, the U.K. and South Africa – the compounds used for the study were manufactured at the Chemistry labs at the Laboratory. While Dr. Adam waits for results of the drug testing, he anticipates the opportunity to develop new compounds in pursuit of novel methods to fight malaria. "*It is exciting that even though we are as far removed from the ravages of malaria as you can possibly be in Vancouver, one can still make a contribution to its treatment.*" The use of these drugs in commercial settings would represent another life science achievement for **TRIUMF**'s scientists.

Innovative Diamond-Like Carbon Foils Made at TRIUMF

Carbon foils are being used at particle accelerators everywhere as extractor or stripper foils – as such, these are a very important part of many of the subatomic processes that take place at **TRIUMF**. When these films became unavailable from a foreign supplier, Dr. Stefan Zeisler and Vinder Jaggi had to get creative. They came up with a way to make these foils in-house, using a well-known process called Carbon Arc Deposition. The process involves the sublimination of a material, in this case amorphous carbon, onto glass slides, such that a film can be deposited and removed easily and afterwards used to extract beams. In their attempt to find an adequate film for MDS Nordion's cyclotrons, these two researchers and a colleague from Texas (Dr. Nalin Kumar) discovered the benefits of layering foils in a sandwich-like manner with diamond-like carbon in the centre of two amorphous carbon layers.

Vinder Jaggi and Stefan Zeisler examining carbon deposition slides used in foil production

Using this new technique, the types of film that can be constructed are quite variable – not only can the scientist using the film change the number and order of the layers, he/she can also change the relative thickness of the layers according to the desired performance of the composite film. Typically, thin foils can be made to measure 5µg/cm^2 to 100µg/cm^2; however, the new foils made at **TRIUMF** are at an astounding weight of 200µg/cm^2 to 300µg/cm^2. Other benefits of using diamond-like carbon include extreme hardness, optical transparency, chemical inertness, and high-wear resistance, all of which enable longer foil lifetime. Since the film would be more durable, replacement time would diminish, allowing decreased radiation exposure to maintenance personnel and lower foil replacement costs. Having these higher-quality foils also allows the researchers to use higher beam densities in their experiments while causing less graphitization of the carbon in the foil.

Vinder Jaggi measuring the thickness of a diamond-like carbon foil

Official patent applications have been filed for this technology. For the future, these two researchers see applications in nuclear medicine, PET centres, the radiopharmaceutical industry or even a possible spin-off venture, in addition to providing **TRIUMF**'s cyclotron users with high-quality, durable foils. They were excited about the possibilities with laser ablation techniques specifically, and hope that **TRIUMF**'s recent laser purchase will continue to streamline their manufacturing process and inspire innovative foil production methods.

TRIUMF's Business Development Plan, 2006-2010

In 1994, the Canadian federal government began a new policy of funding for **TRIUMF** that provided more accountability and built-in performance measures. A five-year Contribution Agreement began in 1995, with requirements for **TRIUMF** to submit a new Business Development Plan every five years.

The latest Business Development Plan was released on March 31, 2006, and covers the 2006 – 2010 period. This report displays the rigorous measures that are in place to maintain **TRIUMF** as Canada's premier sub-atomic physics research centre, while at the same time contributing valuable improvements to the Canadian economy and society. Knowledge transfer from research to industry is currently the major theme and main focus of economic impact at **TRIUMF**. The Plan highlights many of **TRIUMF**'s achievements from 2001-2005 as well as some of the major projects undertaken and future aspirations.

Alan Shotter, Director of **TRIUMF**, is pleased with the Laboratory's achievements and enthused about future prospects: *"As this Plan shows, the laboratory is well positioned to continue its impressive accrual of benefits to Canada.* ***TRIUMF*** *looks forward to the next four years with continued optimism and confidence."* The researchers and staff who work tirelessly at **TRIUMF** are very proud of their accomplishments in knowledge transfer, and look forward excitedly to more creative discovery and beneficial contributions to society.

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