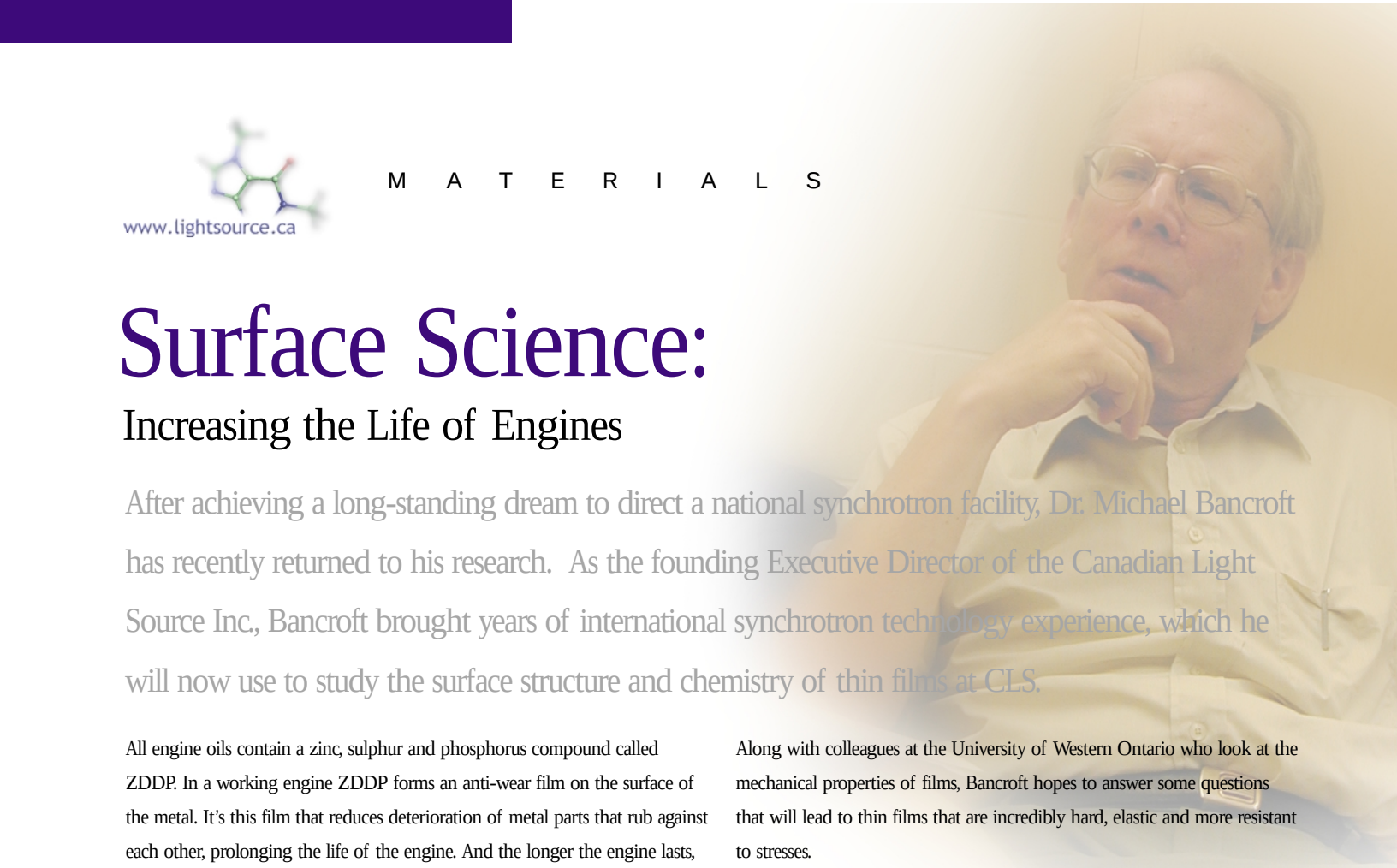
www.lightsource.ca

M A T E R I A L S



Surface Science:

Increasing the Life of Engines

After achieving a long-standing dream to direct a national synchrotron facility, Dr. Michael Bancroft has recently returned to his research. As the founding Executive Director of the Canadian Light Source Inc., Bancroft brought years of international synchrotron technology experience, which he will now use to study the surface structure and chemistry of thin films at CLS.

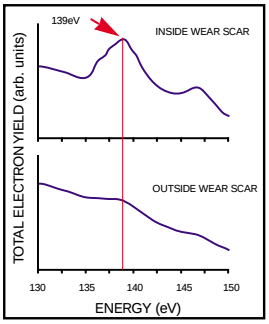
All engine oils contain a zinc, sulphur and phosphorus compound called ZDDP. In a working engine ZDDP forms an anti-wear film on the surface of the metal. It's this film that reduces deterioration of metal parts that rub against each other, prolonging the life of the engine. And the longer the engine lasts, the more economical it is for its owner.

So improving the durability and effectiveness of these anti-wear films is of great interest to both the auto manufacturing and oil industries. Bancroft will use Photo Absorption Spectroscopy techniques at CLS to learn things like whether or not there are better compounds than ZDDP, what forms a good film versus a bad film, and how compounds adhere and form films on different kinds of metal. Why is this important?

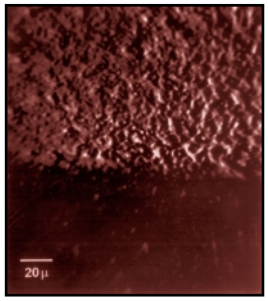
"Well, for example, some car companies are interested in changing from steel to aluminum to build engines," Bancroft says. "It's advantageous because of the difference in weight. But ZDDP may not create the same kind of film on aluminum that it does on steel, so we may need to develop new compounds."

Along with colleagues at the University of Western Ontario who look at the mechanical properties of films, Bancroft hopes to answer some questions that will lead to thin films that are incredibly hard, elastic and more resistant to stresses.

(A)



(B)



G.W. CANNING, G.M. BANCROFT ET AL. TRIBOLOGY LETTERS, 6, 159, 1998.

But it isn't only engines that Bancroft is interested in protecting with better thin films.

"We're developing films with remarkable properties, films that can protect anything from steel to gold," he says. "They're very stable, and will attach to anything. We can even control the thickness."

If stable films can be developed with varying thicknesses, any number of metal products can be protected from oxidation…even cheap jewelry, or silver and gold mirrors. "A company that makes aluminum parts for satellites in space is interested in our work," he says, "and we're also working on how to put films on plastics and semiconductors."

Wear Protection

PHOSPHOROUS "ABSORPTION SPECTRA," (A) AND PHOSPHOROUS MICROSCOPIC IMAGE (B) OF AN ANTIWEAR FILM FORMED BY DECOMPOSITION OF ZDDP ON STEEL. THE SPECTRUM SHOWS THAT THE FILM IS MAINLY COMPOSED OF A ZINC POLYPHOSPHATE, AND THE IMAGE SHOWS THAT THE FILM (TOP PART OF FIGURE B) IS VERY PATCHY, WITH "PADS" OF DIAMETER RANGING FROM LESS THAN A MICROMETER TO OVER FIVE MICROMETERS. THE LARGE PADS ARE INCREDIBLY HARD AND ELASTIC AND PROVIDE EXCELLENT WEAR PROTECTION.

Synchrotron Science Applications

- Understanding and preventing corrosion in oil pipelines
- Developing more efficient and longer lasting lubricant coatings
- Examining contaminants in soils
- Improving the productivity of catalysts