Towards the inexpensive solar cell

Amorphous silicon: an intriguing new material

A team of researchers in Montreal is making thin films of a material in which light can be turned to electric power. It is known as amorphous silicon, and it has the promise of dramatically reducing the cost of solar cells. Curiously, the researchers are learning how to make it without fully understanding how this subtle new material works.

"A plasma really is a terrible mess," Mike Wertheimer says, pointing to a table listing the 34 distinct chemical reactions that occur when oxygen is in that mysterious state of matter. "Until theory can catch up, our work is empirical."

Wertheimer, a bearded and affable professor of Engineering Physics at Montreal's *École Polytechnique*, is co-inventor of a plasma generator (called LMP, for large volume microwave plasma generator). It looks like a big glass tube surrounded by copper ducts. When switched on it hisses and glows in violet hues — aurora borealis in a bottle.

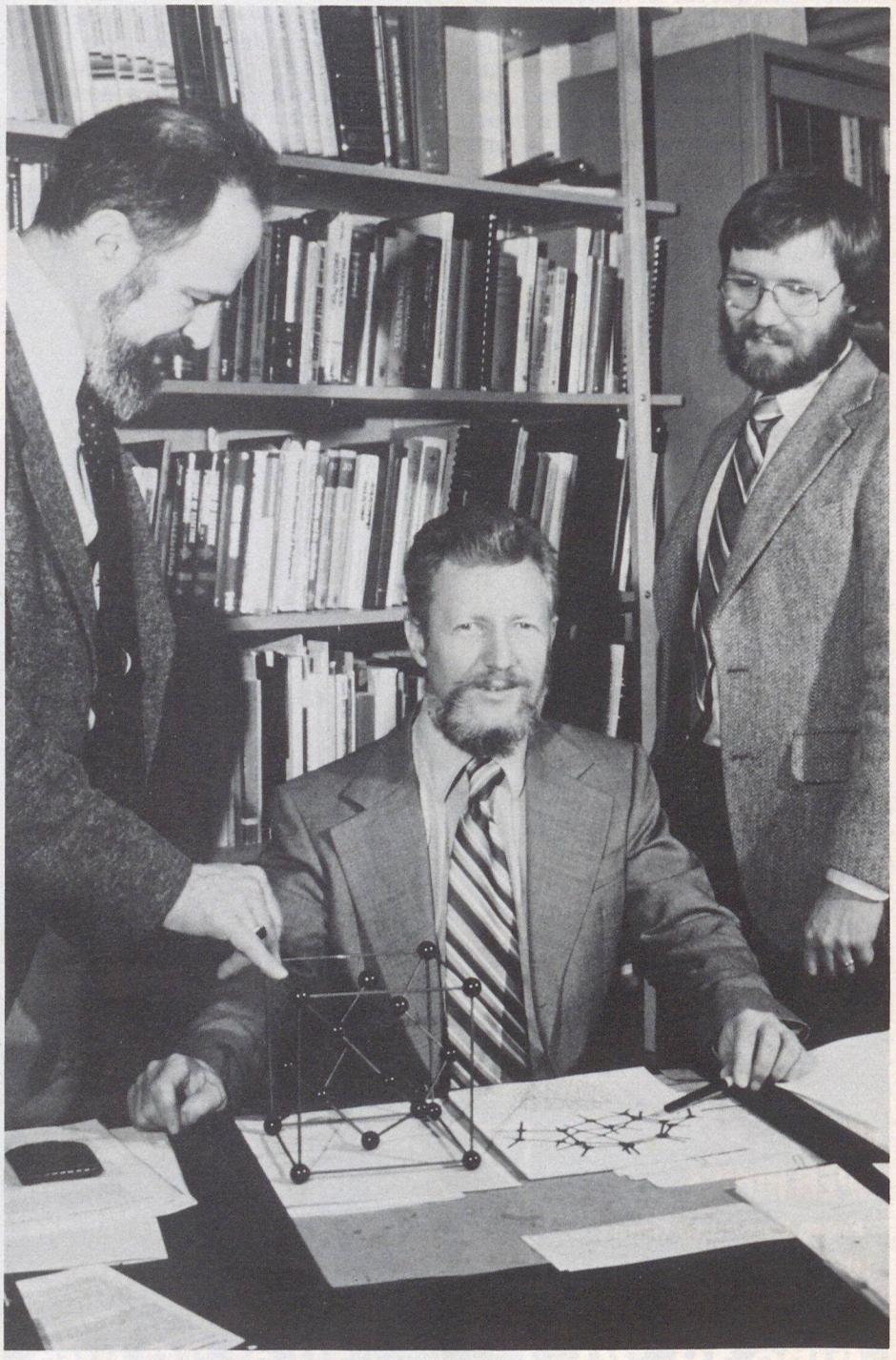
Pretty colors, of course, are not the point. The microwave-accelerated electrons dashing around inside the reactor collide with, and rip apart the molecules of the gas flowing through it. (The colors are from the light emitted by excited molecules.) Under the right conditions, these molecular fragments can stick to a surface, of metal, say, or glass, to form a solid film.

No one can explain all the subtleties of plasmas, but inventors can and do apply them to many useful ends. Wertheimer's plasma generator is a solution in search of problems. It can, for instance, deposit insulation on conductors, coat lenses, or make inexpensive solar cells of an intriguing new material known as amorphous silicon.

Collaborating to explore this last possibility are three research groups, all located on the northern slope of Montreal's mountain: the Solid State and Applied Nuclear Physics groups in the Physics Department of the *Université de Montréal*, and the Solid State Physics group in the Engineering Physics Department at the affiliated *École Polytechnique*. The research team, led by Wertheimer, is funded by the Natural Sciences and Engineering Research Council (NSERC), under a two-year strategic grant for energy research.

All solar cells are made from materials known as semiconductors. In these materials, electrons have just the right degree of attachment to atoms — neither as tightly bound as insulators such as glass nor as loosely bound as conductors such as copper. As a consequence, in semiconductors, electrons can readily be controlled by the small electrical forces generated by adding impurities (see box).

Conventional solar cells are made from pure and elaborately processed single crystals of silicon. Right now, they are expensive; though they are affordable for use in space, cost prohibits their widespread use on Earth. Many people feel, however, that less expensive solar cells could be made



Discussing the structure of amorphous silicon: Drs. Arthur Yelon, Michael Wertheimer, and John Currie (from left to right).

De gauche à droite: Les Drs Arthur Yelon, Michel Wertheimer et John Currie, discutant de la structure du silicium amorphe.