PPPL
PRINCETON PLASMA PHYSICS LABORATORY
HOTLINE

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Getting Ready for Tritium

Operational Readiness Reviews

With scheduled deuterium-tritium (D-T) operations targeted for July 1993, the attention of many in TFTR and ES & H, as well as all supporting groups, is focused on getting ready. Not only is there much to do to prepare for tritium itself, there is also the major task of proving to ourselves and to the Department of Energy (DOE) that all preparations are in place.

Through the Operational Readiness Review (the ORR), preparedness will be carefully examined. According to John DeLooper, Associate Director for Environment, Safety and Health/Quality Assurance, the ORR asks the question, "Can you successfully do what you say you're going to do?"

"The depth and rigor of the upcoming ORR process will make the Tiger Team review seem mild by comparison," noted TFTR Project Head Rich Hawryluk during a mid-March meeting to describe the ORR process to those most involved. "We will need your help and cooperation, because we will have more people looking over our shoulders than we've ever had before," he added.

The trend at DOE is ultraconservative when it comes to handling radioactive materials because of previous releases of tritium at restarted facilities. Said DeLooper, "DOE is sensitive to the *cause* of the release, not the *quantity*. A 0.4 Curie release of tritium shut down another DOE facility." Documentation is also essential. The policy is, "If it isn't documented in strict accord with conduct of operations rules, it hasn't been done."

Ron Strykowsky (left) of the Cost and Schedule Control Office and Health Physicist David Speed review MORT charts for the Environment, Safety, and Health Division in preparation for the upcoming Operational Readiness Reviews.

Photo: Dietmar Krause

Tritium to be Introduced in Two Phases

The Lab plans to introduce tritium in two phases. In late August or early September 1992, a small amount (1000 Curies) of tritium is scheduled to be introduced into TFTR. Known as the "1000 Curie (Ci) Test," this first phase is designed to test the use of tritium while minimizing its impact. Phase two is scheduled to begin in July, 1993 when the full deuterium-tritium transition will be made.

But before *any* tritium is introduced, readiness must be ascertained in three basic areas: hardware and facilities; personnel; and procedures and management systems.

Between now and the 1000 Curie (Ci) Test, three distinct "preparedness checks" will take place. First, the Laboratory itself will perform a review and declare itself ready for the outside reviews. Then, in June, a separate independent

continued on page 2

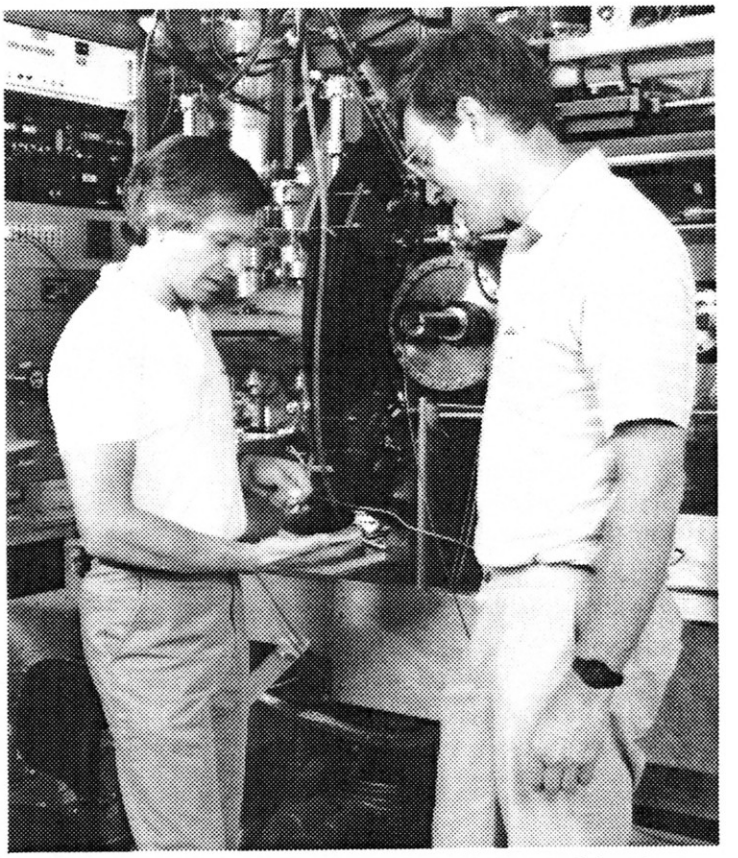
Plasma Processing at PPPL

At PPPL, tokamaks, plasmas, and fusion are usually thought of together. But plasmas have many other applications as well. For example, a plasma can be utilized as a gas discharge that can *etch* complex patterns or *deposit* semiconducting or insulating films onto semiconductors. Semiconductors are crucial parts of nearly every modern electronics system—from computers, to microwave ovens, to communications satellites.

Here at the Laboratory, the Plasma Processing Research Group focuses on developing reactors to etch devices and structures of submicron dimensions. An electron cyclotron resonance (ECR) plasma etch reactor has been designed and built and has been in operation here since June of 1989.

According to Joe Cecchi, who heads the Group, "Etch tools based on ECR plasmas offer numerous potential processing advantages over other etching techniques, including reduced damage to the silicon substrate and to the devices being etched. However, before we can take full advantage of ECR plasmas, we need a more complete understanding of the very complex ECR processing environment."

continued on page 3



Joe Cecchi (left) and Jim Stevens stand in front of the electron cyclotron reactor (ECR) as they examine a silicon wafer prior to etching. Photo: Dietmar Krause

Getting Ready

continued from page 1

review (contractor ORR) will be done. After their three to four week review, the nine reviewers will issue their report on how ready PPPL truly is.

Third, the Department of Energy will perform the governmental ORR. In addition to these two ORRs, the DOE Office of Nuclear Safety and the DOE Office of Environment, Safety, and Health will double check the work of the DOE ORR team. Also, oversight function will be performed by the Princeton Area Office, Chicago Operations, and Energy Research.

Before phase two (D-T Operations) can begin, a similar series of two readiness reviews will again take place. The contractor ORR is scheduled for May 1993, with internal review completed beforehand, and the DOE ORR to follow.

MORT

To get ready for the ORRs, a preparedness task force has been appointed that includes Tom Walters, John DeLooper, Myron Norris, J.W. Anderson, and Ron Strykowsky. The approach being used is a tool called a MORT—a Management Oversight Risk Tree Analysis.

This elaborate system of charting and checklisting tasks to be accomplished is designed to provide a comprehensive evaluation of what is required for the 1000 Curie Test and again for D-T operations. Although time consuming and difficult to assemble, it is hoped that use of the MORT charts will minimize the time oversight groups will need to spend reviewing TFTR before authorizing tritium use.

Anderson observes, "These MORT charts are like roadmaps of major tasks based on predictions of what ORR reviewers will be checking. For those doing the hands-on work, the charts provide a logical visual map that will help them organize their thoughts and decide how best to approach the tasks at hand." Strykowsky has been given the task of developing the tree charts. He says, "Thus far, we've been identifying the *scope* and *responsibility* of tasks for each group. Next, we must clarify *specific* tasks and items to be produced and (the key question) *when* they will be completed."

Plasma Processing

continued from page 2

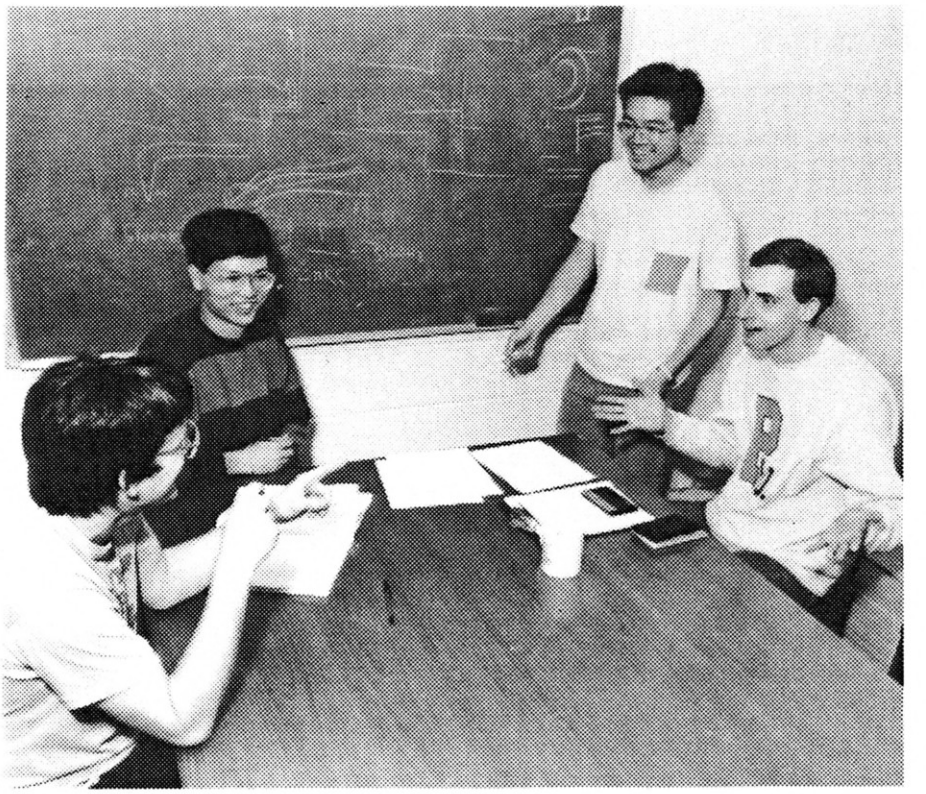
"Therefore," adds Cecchi, "our main objective is to investigate generic ECR issues that will increase this understanding and allow us to develop and transfer the appropriate technology to industry. We are focusing on issues like microwave coupling, impurity control, and discharge conditioning. Extensive diagnostic techniques are being used to determine the correlation between plasma parameters and etching characteristics. Some of these diagnostics are spin-offs of fusion research at the Lab."

Collaboration Key

At every level—state, industry, university, and federal research laboratory—cooperation and collaboration have been key in bringing plasma processing research to PPPL. First, in March of 1988, the New Jersey Consortium for Surface Processing came into being. Its purpose is to take advantage of the aggregation of resources available through its five members: Princeton University, Rutgers University, the David Sarnoff Research Center, the New Jersey Institute of Technology (NJIT) and Stevens Institute of Technology.

The Consortium approach paid off for New Jersey when their proposal to establish a SEMATECH Center for Excellence (SCOE) in Plasma Etching was accepted in May, 1988. SEMATECH , located in Austin, Texas, is a consortium of 13 United States semiconductor manufacturers. Their mission is to provide United States industry with the domestic capacity for world leadership in semiconductor manufacturing. They sponsor eight other SCOEs around the country as well.

At Princeton, collaboration has been important between PPPL and the University's Department of Chemical Engineering and Princeton Materials Institute (PMI). Joe Cecchi, who has been Principal Investigator for the Princeton effort from its inception, holds a joint appointment at the Lab and in the Chemical Engineering Department. He is also a member of the PMI faculty. On January 1, 1992 Cecchi was appointed Director of the entire New Jersey SCOE.



Graduate students (left to right) Rob Jarecki, Yuan-Chang Huang, C. W. Cheah, and Chris Zuiker discuss their research related to plasma processing.

Photo: Denise Applewhite

Cecchi originally proposed the project and regards his main responsibility to be the supervising of graduate students who are working on their PhD theses in the SCOE. At present, they are: Chris Zuiker and Steve Cauffman of Astrophysical Sciences, and C.W. Cheah, Y-C Huang, and Rob Jarecki of Chemical Engineering. A former Astrophysical Sciences student, Mark Bannister, received his PhD and is now on staff at Oak Ridge National Laboratory.

Senior Lab and Shop staff member Silvester Luyber has been indispensable to the project. He has designed and fabricated almost all the ECR plasma etch reactor parts, including the diagnostics. His expertise in machining, welding, and vacuum technology have been key to the project's success.

Jim Stevens, Principal Research Physicist, has also been a key participant from the start. Stevens, an expert in wave heating of plasmas, has made important contributions to optimizing coupling of microwaves to plasmas and determining how microwave power is absorbed.

Stevens and Cecchi have received two awards from the Semiconductor Research Corporation for their patents on ECR couplers.

As Director of the New Jersey SEMATECH Center for Excellence for Plasma Etching, Cecchi oversees each phase of activity at all five

continued on page 4

Plasma Processing

continued from page 3

member institutions. While about half the work in plasma processing takes place here at the Lab and on Main Campus, the project also takes advantage of the plasma expertise and semiconductor experience of Sarnoff; the surface analysis capacities of Rutgers; the devices analysis capabilities of NJIT; and the spectroscopic strengths of Stevens.

The SCOE work is carried out in close collaboration with a number of industrial companies, including Applied Materials, AT&T, Drytek, IBM, Intel, Motorola, Texas Instruments, and SEMATECH itself. Such collaborations ensure the relevance of the work and facilitate rapid technology transfer. Collaboration also benefits the students by exposing them to the semiconductor manufacturing environment during their graduate work.

Meeting Lab Objectives

The PPPL work within the New Jersey SCOE addresses a number of important Laboratory objectives. The project provides a good example of the transfer of fusion technology to important near-term industrial needs. It also serves as an excellent focus for graduate education. In addition, it has promoted extensive collaboration with main campus, and with other institutions that have complementary expertise.

In replacing the older, hazardous methods of wet chemical etching, the technology of plasma etching makes a positive contribution to the environmental, safety, and health aspects of the semiconductor industry. And finally, plasma processing provides a new frontier for the Laboratory, which carries on the 40-year tradition of contributing to plasma science and technology.

Senior Laboratory and Shop staff member Silvester Luyber inspects his welding of the electron cyclotron reactor chuck. The chuck holds the wafer during etching.

Photo: Dietmar Krause

ESU
FIRE SAFETY TIP

Cool a Burn

If you or someone else gets burned, run cool water on the burned skin immediately. This will help lessen the pain. If a blister or char forms, see a doctor right away.

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What's Happening at PPPL?

Congressman Dick Zimmer (right) and Mike Williams, Head of PPPL Engineering, took a tour of TFTR along with several members of the Science, Space, and Technology Advisory Board after a meeting held here on March 27. PPPL Director Ron Davidson and former Director Harold Furth are Board members. The Board is made up of constituents of the 12th Congressional District, New Jersey, for which Zimmer is U.S. Representative. (Under the new redistricting, the 12th District now includes Plainsboro and PPPL.)

Photo: Dietmar Krause

Express Your Gratitude!

Secretaries' Week— April 20-24

Whether with a card, a luncheon, flowers, or a simple expression of thanks, now's the time to let secretaries know how much they are appreciated.

It's no secret that top-notch secretaries make the world of offices go around. Thanks to all secretaries here at PPPL for your hard work!

HOTLINE

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Happy Easter!
Happy Passover!