Role of defects in reduced dimensional systems I
Plummer, University of Tennessee, DMR-0105232

A phase transition is a cooperative phenomenon involving the concepts of broken symmetry and dimensionality. It has long been recognized that changing the dimensionality of a system has profound effects on phenomena associated with phase transitions. It is also anticipated that defects will play a larger role in phase transitions in low-dimensional systems, though microscopic evidence has been limited.

While studying phase transition in 2D system of Sn/Ge(111) using Scanning Tunneling Microscope we have observed on atomic scale that point defects not just modify some parameters of the phase transition but can completely control its nature. Such observation initiated a study of such influence in the whole class of 2D systems that will lead to new understanding of the behavior of the defect populated low dimensional systems.

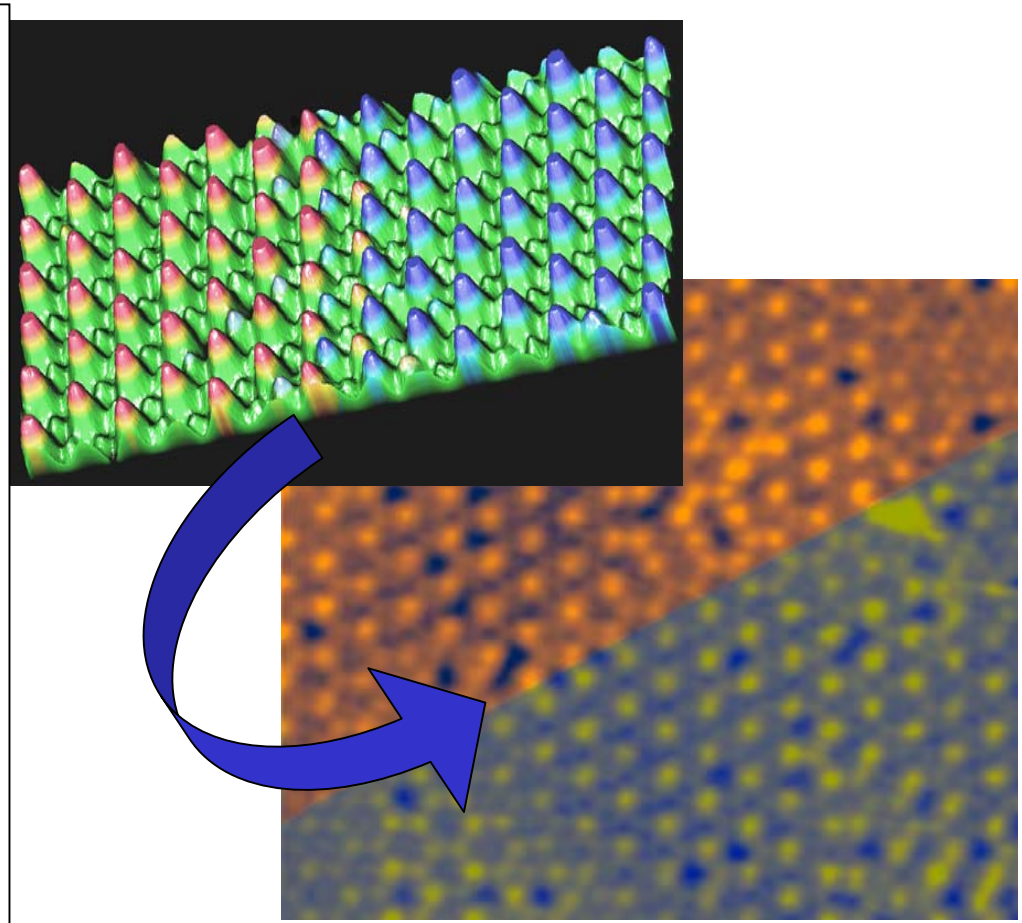

Image above: An artist's rendition of the STM image of a wall between two domains (red on the left and blue on the right) of the low temperature phase of Sn/Ge(111).

We developed a model that shows that location of the domain walls are completely controlled by position of defects on the surface (dark spots in the STM image below.)

Role of defects in reduced dimensional systems II
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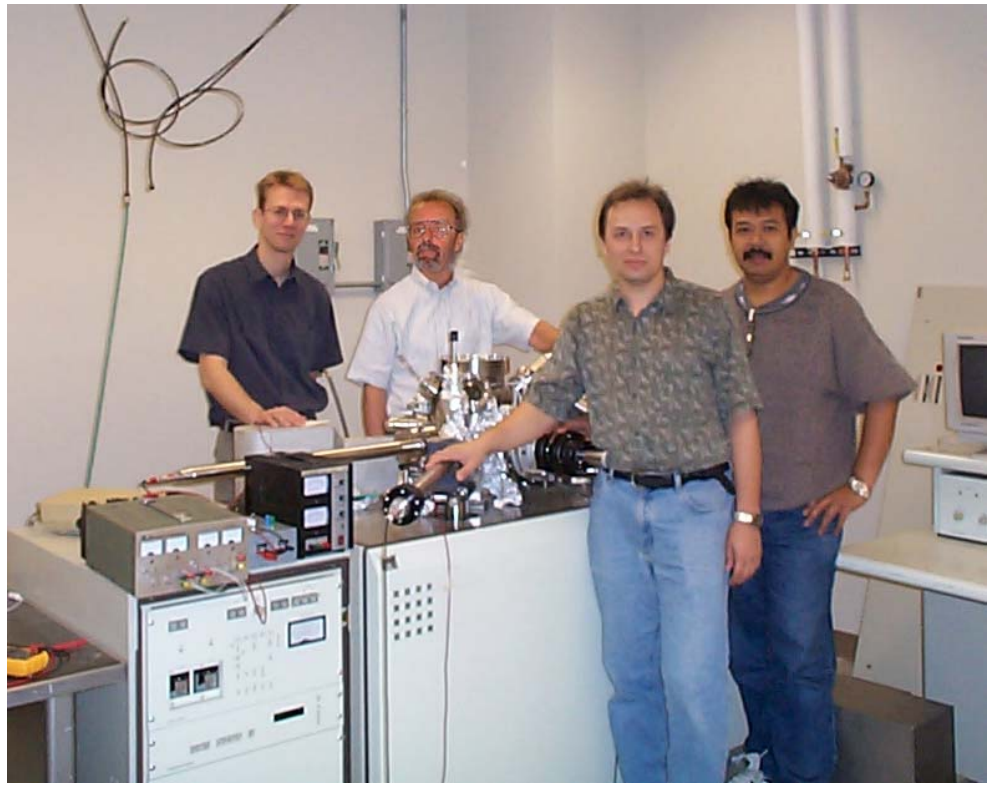
Anatoli Melechko (second from right) first became involved in this work in 1996 as a graduate student. He finished his Ph.D. in January 2001. Now he is a research Assistant Professor at the Department of Electrical and Computer Engineering, University of Tennessee.

Ismail (far right) is a post doctorate fellow with Ward Plummer. He has been involved in this project since 2001, and continue to study focused on the role of defects on surface phase transition and highly correlated electron systems.

To expose the first- and second-year undergraduates in Plummer's Modern Physics course to cutting-edge physics, Anatoli presented the results of these studies as a guest speaker. The young students learned about the exciting physics, should they choose to continue their studies at a higher level.



This project, a partnership between the University of Tennessee and Oak Ridge National Laboratory, has allowed Anatoli, Ismail, and Ward to benefit from a close collaboration with the Lars Petersen in the Solid State Division at ORNL. In the back row, from left to right, are Lars Petersen from ORNL and Ward Plummer.