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Invited (Physics Department Colloquium)

## **The Dynamic Role of Defects in Two-Dimensional Systems**

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The variable temperature scanning tunneling microscope is presenting an unparalleled atomic view of the importance of defects in all forms of surface phenomena. What is most surprising is that in many cases it is the dynamic behavior of the defects that is crucial. In this talk I will discuss two examples illustrating the need for a new paradigm to describe real surfaces at finite temperatures. The first example is associated with a complex symmetry lowering ( $\sqrt{3}\times\sqrt{3}$ ) to  $(3\times 3)$  phase transition in an ultra-thin film of Sn on Ge(111). In this system and similar systems the transition can be decomposed into two intertwined phase transitions: a second order Charge Density Wave-like transition and a first order disorder-order transition in the defect distribution. The second example is from the beautiful work of the Salmeron group on the role of subsurface impurities in Pd(111). These mobile impurities, which have been identified as O and C, interact with adsorbed atoms and molecules, limiting surface diffusion, nucleating island growth, serving as active sites for surface reactions, and decreasing the dissociation energy of adsorbed molecules. Indeed, it is time to rethink our basic concepts about surface dynamics. Defects and impurities are always present!

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