Yishay Manassen
Department of Physics, Ben Gurion University, Israel

TITLE:
Electron spin resonance scanning tunneling microscopy on Si(111) containing C and O defects

ABSTRACT
ESR-STM is a technique capable of single spin detection. In this seminar I shall describe the technical aspects of the detection, the main observations in the past and recent results: Clean and C-rich Si(111)7x7 surfaces exposed to 0.1L of O_2 are investigated by electron spin resonance scanning tunneling microscopy (ESR-STM). On clean Si(111)7x7, spatially averaged ESR-STM spectra exhibit a sum of a strong, 10MHz wide peak corresponding to g = 1.998 and a weaker triplet of smaller peaks with width 2 MHz, total splitting A = 9 MHz and a central peak corresponding to g = 2.006. The wide peak is attributed to the dangling bond of Si(111), while the triplet is attributed to vacancies in partially C-rich Si areas, which are hyperfine split by interaction with nearby 28Si and 29Si. The triplet intensity is enhanced in C-rich Si(111)7x7 samples, which are prepared without degreasing the sample and confirmed to be C-rich by Auger electron spectroscopy, low-energy electron diffraction and STM. Frequency sweeps at constant B and B field sweeps at constant frequency reveal consistent results on this surface. More local ESR-STM spectra differ and exhibit either only the central peak of the triplet or a more complex structure as expected from different nuclear environments. Interestingly, the triplet exhibits two peaks (one of them with a derivative shape) and one dip which could be modeled by introducing dynamic spin polarization of the leads via the so-called radical pair mechanism based on a multiple encounter between the lead electrons and the localized spin in combination with sequential tunneling between the two leads via a localized spin level. In agreement with this model, the spectral appearance changes with sample bias polarity.