A Low Temperature Scanning Tunneling Microscopy System For

In this thesis, the electronic properties in superconducting LiFeAs single crystal are investigated using low temperature scanning tunneling microscopy and spectroscopy (STM/S) at various temperatures. For this purpose, the differential conductance (dI/dV) measured by STS which is directly proportional to the local density of states (LDOS) of the sample to the sub-atomic precision, is used together with the topography information. The dI/dV spectra within the ±1 V energy range reveal a characteristic feature at around -350 mV to -400 mV in stoichiometric LiFeAs. This feature seems to be a universal property among all the Fe-based high temperature superconductors, because it is also found in Fe0.965Se1.035 and NaFe0.975Co0.025As single crystals at the energy of -210 mV and -200 mV, respectively. The temperature dependent spectroscopy data averaged over a spatially fixed clean area of 2 nm × 2 nm are successfully executed between 5 K and 20 K. The two distinct superconducting phases with critical temperatures Tc = 16 K and 18 K are observed. In addition, the distance between the dip position outside the superconducting gap and the superconducting coherence peak in the spectra remains temperature independent which confirms that it is not connected to an antiferromagnetic (AFM) spin resonance. The temperature dependent spectra have been measured between 5 K and 61 K within the energy range of ±100 mV as well. The hump structure at 42 mV tends to disappear around 60 K from unknown origin. The temperature dependent quasiparticle interference (QPI) has been studied within the temperature range between 6.7 K and 25 K and analyzed by the Fourier transformation of the measured spectroscopic maps. The dispersion plots in momentum space as a function of temperature show an enhancement of QPI intensity (±5.5 mV) within the superconducting gap at the Fermi level at 6.7 K near q ~ 0. This is interpreted on the basis of Andreev bound state. In both polarities outside of this, a dep

Il fut utilisé pour une étude topographique et spectroscopique du supraconducteur classique 2H-Nb1-xTaxSe2(x=0,0.03,0.1,0.15 et 0.2) et du supraconducteur à haute température critique Bi2Sr2CaCu2O8.

The second part of this work gives a detailed description of the development of a low temperature scanning tunneling microscope. Although many groups using various approaches have worked on this subject, the design of a high performance low temperature scanning tunneling microscope (LTSTM) is still very challenging. We present here the design of our LTSTM, which has a special configuration and can be mounted on one of our dilution refrigerator cryostats. The system also employs a novel and effective vibration-isolating mechanism. We also present images obtained with this instrument.

Nanotechnology is described as an emerging science discipline that is expected to have a greater impact on life as we know it than any innovation since the industrial revolution. Superior, cheaper, stronger and more efficient products are predicted to change the way we live, use technology and conduct research. This dissertation focuses on a remarkable instrument, the low temperature scanning tunneling microscope (LT-STM), which is a powerful tool that has played a significant role in revolutionizing the fields of nanoscience and nanotechnology. The work in this dissertation is divided into three sections. First, the fundamental principles of nanoscience and the history of microscopy are introduced. The second part provides a thorough study of Bardeen's formula and its application in STM. The third part describes experimental investigations involving the physicochemical properties of matter at the nanoscale conducted by means of LT-STM. Studies begin with bare substrate surfaces and successively build in complexity as small molecules, solvents, nanoclusters and large organic molecules are examined on surfaces. Experiments show that carbon monoxide exhibits chemical contrast, while oxygen shows a lack thereof. Solvents are demonstrated to weaken surface bonds and induce surface atom mass transport and the tip is shown to assist the diffusion. Manganese nanoclusters are shown to generate a localized electronic state on graphite by either an electronic or magnetic perturbation. The aromatic molecule, decacyclene (DC) is shown to exhibit both bias-dependent and tip-dependent contrast reversal. In addition, intermolecular interactions are found to compete with the surface-to-molecule interactions as dimers are observed on the surface. Two geometric orientations of the dimers are proposed to explain dimer characteristics and their relation to substrate-dependent properties. Lastly, DC molecules are examined at coverages in excess of a monolayer and shown to form ordered domains of the boat-shape conformation. This dissertation emphasizes the local modifications of electronic structures upon physisorption and the interplay between surface-to-molecule and molecule-to-molecule interactions, which demonstrate the various complexities occurring at the nanoscale.

The authors present the design and first results of a low-temperature, ultrahigh vacuum scanning probe microscope enabling atomic resolution imaging in both scanning tunneling microscopy (STM) and noncontact atomic force microscopy (NC-AFM) modes. A tuning-fork-based sensor provides flexibility in selecting probe tip materials, which can be either metallic or nonmetallic. When choosing a conducting tip and sample, simultaneous STM/NC-AFM data acquisition is possible. Noticeable characteristics that distinguish this setup from similar systems providing simultaneous STM/NC-AFM capabilities are its combination of relative compactness (on-top bath cryostat needs no pit), in situ exchange of tip and sample at low temperatures, short turnaround times, modest helium consumption, and unrestricted access from dedicated flanges. The latter permits not only the optical surveillance of the tip during approach but also the direct deposition of molecules or atoms on either tip or sample while they remain cold. Atomic corrugations as low as 1 pm could successfully be resolved. In addition, lateral drifts rates of below 15 pm/h allow long-term data acquisition series and the recording of site-specific spectroscopy maps. Results obtained on Cu(111) and graphite illustrate the microscope's performance.

The present work presents the results of low temperature STM and STS investigations of (110) surface of GaAs monocrystals doped with impurities of different kind.

Design and Construction of a Low Temperature Scanning Tunneling MicroscopeStudies of Superconductors Using a Low-temperature Scanning Tunneling MicroscopeDesign and Construction of a Low Temperature Scanning Tunneling Microscope for Studying High Temperature SuperconductivityLow Temperature Scanning Tunneling SpectroscopyStudies of the High-Tc Supercondctor Bi2Sr2CaCu20x Using Low Temperature Scanning Tunneling MicroscopyDesign of a Low-temperature Scanning Tunneling Microscope System Used to Examine Graphene NanomembranesA Low Temperature, Ultrahigh Vacuum, Microwave-Frequency-Compatible Scanning Tunneling Microscope

To expand the capabilities of the microwave frequency alternating current scanning tunneling microscope to include the ability to study isolated adsorbates and highly reactive surfaces, we have developed a low temperature, ultrahigh vacuum alternating current scanning tunneling microscope. In this alternating current scanning tunneling microscope, we employ the reliable beetlestyle sample approach mechanism with a number of other components unique to a low temperature scanning tunneling microscope. These include the sample transfer, delivery, retrieval, storage, sputtering, and heating systems. This alternating current scanning tunneling microscope has been operated at 77K and 4K.

Zsfassung in niederländ. Sprache.

In this contribution, we will demonstrate the possibility to study size effects in thin films of AuFe spin-glass alloys by investigating the differential conductance near the Fermi level with low-temperature scanning tunneling spectroscopy (STS). As confirmed by point contact expenments, the voltage dependence of the differential conductance can be directly linked to the tempereture dependence of the resistivity 8. The STS measurements provide the unique possibility to probe possible spatial variations of the size effects. Moreoven combining the STS measurements with topographic scanning tunneling micrescopy (STM) images of the surface may allow to check the influence of the local surface roughness on the spin scattering processes.