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„QSE growth and super-diffusive liquid-like motion in Pb/Si(111) at low temperature”

QSE are responsible for the formation of uniform height metal islands at low temperatures[1,2]. For Pb/Si the islands form unusually fast, within a few minutes as low as T~150K. With STM[2] and LEEM[3] it was found that this is due to the superdiffusive “liquid-like” motion of the dense wetting layer that moves collectively with constant speed. Unstable islands transform into stable islands as seen in STM movies with the wetting layer climbing the sides of the unstable islands to complete the next layer. This unusual motion is directly seen by LEEM with the refilling of an initial vacant circular region generated by a laser pulse, evolving at constant speed x/t instead of the normal $x/t^{1/2}$ diffusive motion (with x the profile edge). This novel motion is present above some critical coverage θ_c=1.25ML which corresponds to 5% compression in the Pb layer. Additional LEEM experiments have clarified further the origin of the superdiffusion. An outgoing expanding front is observed whose boundary is the source of material that refills the vacant hole. μLEED provides locally the diffraction pattern and therefore the phase present. The Pb/Si(111) system itself is unusual that numerous phases form (according to the “Devil’s staircase” phase diagram[4] differing by ~0.001ML in coverage) and well resolvable with μLEED. The combined effect is to observe mass transport over macroscopic distances with unprecedent accuracy of 0.001ML and unusual long range correlation between the outwards expanding “source” and the inward moving “sink” (the refilling edge), separated by more than 200μm.

This unusually fast motion of the wetting layer is responsible for the very efficient formation of the uniform height islands and must be related to QSE, but it is still not clear what is its electronic structure. Spectroscopic information with ARPES can reveal more information about the operating mechanism.

In collaboration with M. Hupalo, S. Binz, M. S. Altman, K. L. Man.

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Uprzejmie zapraszam wszystkich pracowników, doktorantów i studentów Instytutu Fizyki.

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