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Two-dimensional quantum well states on vicinal Beryllium surfaces.

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A vicinal surface with monoatomic steps is an interesting example of quasi one-dimensional nanostructured system. Vicinal surfaces of noble metals have been an active field of research in the past years because they offer a natural playground to investigate the behavior of electronic surface states in low dimensional nanostructured systems. Group II metals like Be exhibit several prominent surface states with a large density of states, which in some cases is even larger than the bulk electronic density. For several surfaces, like Be(0001), the surface state has an almost ideal two-dimensional character, since the bulk band gap is very large and the surface is almost decoupled from the bulk. On the other hand, vicinal Be(10-10) offers a novel scenario to investigate how several kinds of surface states are affected by the introduction of a new periodic step potential.

The structure and electronic properties of several Be crystals vicinal to the (10-10) directions have been investigated by Low Energy Electron Diffraction (LEED) and Angle Resolved Photoemission Spectroscopy (ARPES) with Synchrotron Radiation [1]. The long-range ordered terraces and step superperiodicity was investigated by LEED for surfaces with different miscut angles, going from 2.95 to 9 degrees. The electronic structure revealed several prominent features corresponding to a surface resonance (SR) centered at Γ and two surfaces states located at A, in agreement with previous measurements of flat [10-10] surface [2]. Moreover, several additional states between the SR and the Fermi level were found. These bands behave as free-electron like electrons along the direction parallel to the terraces, while they are confined (dispersionless) along the direction perpendicular to the steps. These additional states are in agreement with two-dimensional quantum well states in an infinite potential well model.

References

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