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Radial band structure of a ultrathin liquid metal film[1]

HAN WOONG YEOM, Department of Physics, POSTECH

Understanding the properties of strongly disordered materials has been one of the long standing and most challenging problems in condensed matter physics. One major difficulty lies in the failure of the band structure concept to describe electronic properties due to the lack of the periodicity, as notorious for electrons in liquid metals without any well-established and well-tested alternative until now. In this work, we experimentally, using angle-resolved photoelectron spectroscopy, establish the formation of an intriguing "double radial band structure" in a strongly disordered electronic system of a liquid metal Pb. A monolayer Pb film was formed on Si(111) with an unusually low melting temperature and its detailed band dispersions and Fermi contours were mapped throughout the melting process. Furthermore, we introduce the way to understand this characteristic band structure based on an old theoretical idea proposed in 1962 invoking the coherent radial scattering of electrons, which can be widely encountered in wave scatterings within disordered media. In conclusion, liquid metals, or possibly other strongly disordered electronic systems, have well defined radial bandstructures through the coherent radial scattering of electrons and the radial correlation of atoms.

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