**Shining new light on the motion of eutectic droplets across surfaces: a PEEM study of PtGe on Ge(110)**

Bene Poelsema, Zhiguo Zhang, Junia S. Solomon, Harold J.W. Zandvliet and Arie van Houselt

Physics of Interfaces and Nanomaterials, MESA$^+$ Institute for Nanotechnology, University of Twente, P.O. Box 217, 7500AE Enschede, The Netherlands.

Thermally stimulated motion of micron sized eutectic PtGe droplets on Ge(110) has been studied in-situ by mainly PEEM (Photo Emission Electron Microscopy), LEEM (Low Energy Electron Microscopy) and μLEED (spatially resolved Low Energy Electron Diffraction). Their motion towards regions at higher temperature is driven by the entropy gain of substrate atoms which become constituents of the droplet during their journey. At ~1100K, i.e. well above the bulk eutectic temperature, the direction is governed solely by the local thermal gradient, irrespective of eventual crystalline preferences. Indirect access to the diffusivity of the host material (Ge) inside the droplets reveals that this is about fifty times higher than expected if it were rate limiting for the velocity of the moving droplets. This excludes a significant gradient of the (Ge-) concentration inside the droplet and disqualifies dissolution-diffusion-deposition flow as the driving force for motion of the droplets on the surface as assumed widely hitherto to explain their diffusion. We propose an alternative mechanism for droplet diffusion: The droplets make direct contact with the flat Ge substrate through atomic steps, which are abundantly present at the interface. The droplets are surrounded by a $PtGe_3$ wetting layer with an ordered (2x1) structure. Dissolution of the edges of the wetting layer at the leading edge of the droplet with an activation energy of 2.2 eV is identified as the rate limiting step for its motion.