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Mechanism of high-resolution STM, AFM and IETS-STM imaging with functionalized tips R. TEMIROV, Forschungszentrum Juelich GmbH, Germany, P. HAPALA, Institute of Physics, Academy of Sciences of the Czech Republic, Prague, F.S. TAUTZ, Forschungszentrum Juelich GmbH, Germany, P. JELINEK, Institute of Physics, Academy of Sciences of the Czech Republic, Prague — High-resolution AFM and STM with functionalized tips is well established [1,2], but a detailed understanding of the image mechanism is still missing. Moreover, recently this family of imaging techniques has been complemented by a method based on inelastic electron tunneling spectroscopy [3]. Here we present a comprehensive mechanical and transport simulation model [4,5] that explains essentially all image features in functionalized tip STM, AFM and IETS-STM. Important aspects of the mechanism are: (i) Images are dominantly determined by Pauli repulsion [6], (ii) in STM and IETS STM this force signal is transduced into an elastic [6,7] or inelastic [5] conductance signal, (iii) probe particle relaxation leads to image sharpening [4], (iv) the apparent imaging of hydrogen bonds can be explained by a relaxation effect [4], and (v) electrostatic forces may also influence the image contrast [5]. [1] Temirov et al., *New J Phys* 10, 053012 (2008) [2] Gross et al., *Science* 325, 1110 (2009) [3] Chiang, et al., *Science* 344, 885 (2014) [4] Hapala et al. *Phys. Rev. B* 90, 085421 (2014) [5] Hapala et al. *Phys. Rev. Lett.* 2014 in press [6] Weiss, et al. *Phys. Rev. Lett.* 105, 086103 (2010) [7] Kichin et al. *Phys. Rev. B* 87, 081408(R) (2013)

F.S. Tautz
Forschungszentrum Juelich GmbH, Germany

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