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Magnetic Exchange Force Microscopy[1]

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Magnetic Exchange Force Microscopy (MExFM) is a new technique that was proposed [1] to perform magnetic imaging with atomic resolution. It is based on conventional atomic force microscopy, but uses a magnetic tip, which is approached very closely to a magnetic sample in order to detect the magnetic exchange interaction. Unlike Spin-Polarized Scanning Tunneling Microscopy (SP-STM) [2], it is not limited to well conducting materials. Although theoretical calculations indicate the feasibility of MExFM and several attempts have been made to perform such an experiment, no clear evidence for successful MExFM imaging has been reported so far. To prove the detection of the magnetic exchange interaction between magnetic moments (spins) of tip and sample, we investigated the (001) surface of the prototypical antiferromagnetic insulator nickel oxide. Imaging with atomic resolution was performed in the non-contact attractive force regime using the dynamic mode with frequency modulation. Apart from the chemical contrast between nickel and oxygen atoms an additional modulation originating from the row-wise antiferromagnetic arrangement of the spins at the nickel atoms could be observed. We discuss experimental prerequisites to perform MExFM and present different tests to unambiguously assign the additional modulation to the magnetic exchange force.

[1] R. Wiesendanger et al., J. Vac. Sci. Technol. B **9** , 519 (1990).
[2] S. Heinze et al., Science **288** , 1805 (2000).

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