

Low temperature scanning probe microscopy at high magnetic fields and precise nanositioning tools for extreme environments

Martin Zech, Florian Otto

attocube systems AG, Koeniginstrasse 11a (Rgb), 80539 Muenchen, Germany
martin.zech@attocube.com

attocube systems, the world-leader in low temperature scanning probe microscopy at high magnetic fields, manufactures and provides ultra-high precision spatial positioning systems and complete probing tools, which are particularly suitable for extreme environmental conditions such as cryogenic temperatures (10 mK – 300 K), high magnetic fields (+31 T) and ultra high vacuum environments (up to 5×10^{-11} mbar).

The patented, ultra-compact, nano-precise positioning devices specifically designed for extreme environments provide linear, rotational or tilt movement of samples or probes with a sub-nm precision over large travel ranges of up to 20 mm. They are offered in different sizes and out of a variety of materials, and feature an unprecedented variety of applications. This presents a revolutionary advancement for the positioning market, leading to new research in many areas.

The low temperature Scanning Probe Microscopes (LT-SPM) product line comprises an unmatched variety of different probe techniques such as AFM, MFM, SHPM, CFM, Raman, SNOM and STM, and a whole variety of complete cryogenic systems with base temperatures down to 10 mK and magnetic fields of up to 16 T, including e.g. the only proven low vibration pulse-tube cooler based cryostat on the market specifically designed for LT-SPM. Based on our reliable positioning devices, the SPMs allow for in-situ coarse and fine positioning, smooth scanning or automatically focusing of any samples with respect to any probes at low temperatures, high magnetic fields and under high vacuum conditions.

In addition, we offer customized solutions and special products like the world's smallest interferometric displacement sensor (head size only 6 mm x 3 mm) with a stunning resolution of up to 30 pm even over large distances (> 10 cm), while offering sampling rates as high as 12.5 MHz and an absolute accuracy of ± 0.5 ppm. These capabilities combined with the compactness are unheard of in industrial metrology and drive new applications in interferometric displacement and vibrometry measurements under harsh conditions in research and industry. With applications ranging from closed-loop scanning to square-foot manufacturing and displacement detection in turboshaft- and gas engines, attocube is creating today's solutions for tomorrow's problems.

In view of the paramount importance of nanotechnology in many areas of today's research as well as industry, attocube's products provide a broad range of ideal products for the growing demand of nano-precise tools for investigation of materials down to the atomic level.

For further technical information concerning attocube systems' products, please visit our website
www.attocube.com.

Figures

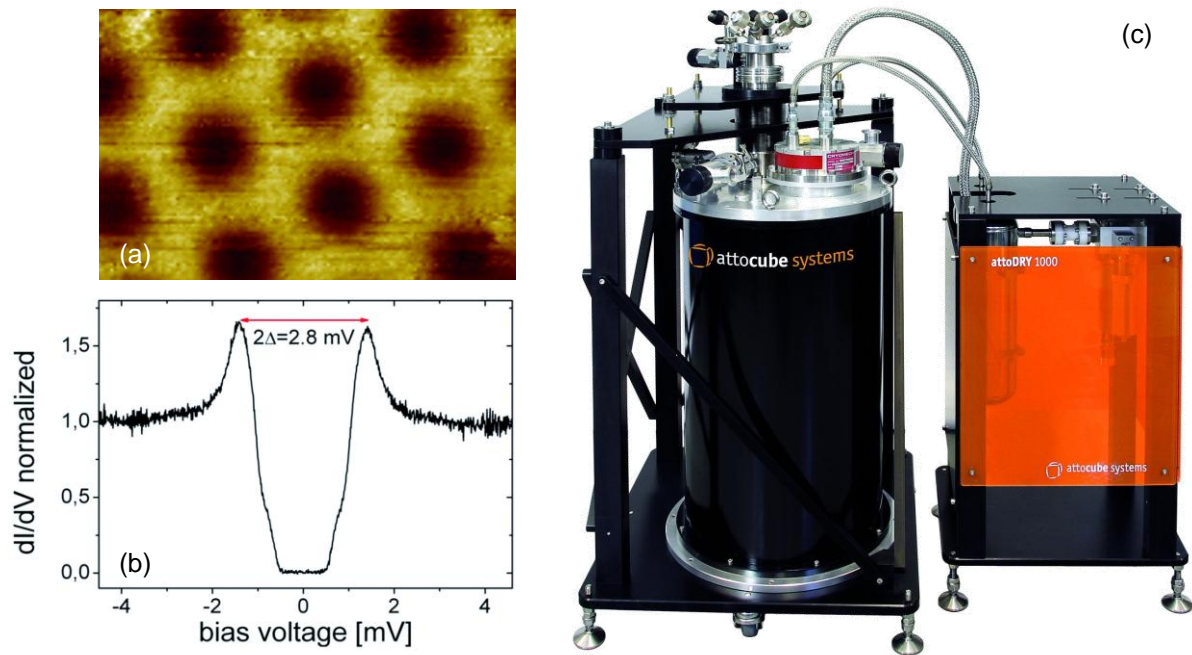


Figure caption: (a) Scanning tunneling spectroscopy (STS) vortex imaging on $NbSe_2$ (Sample courtesy of R. Kramer, Leuven University, Belgium) at 315 mK and 1 T magnetic field. The image was recorded at a bias voltage of 1.4 mV (attocube application labs, 2009). (b) dI/dV spectrum of $NbSe_2$ revealing a local superconducting gap with 2Δ equal to 2.8 mV. (c) The attocube systems cryogenic-free cooling system specifically designed to provide an ultra-low vibration measurement platform for cryogenic scanning probe experiments, without the need for liquid helium.