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Scanning Frequncy Comb Microscopy; A New Tool With SUB-NM Resolution MARK HAGMANN[1], NewPath Research L.L.C., DMITRY YAROTSKI[2], Center for Integrated Nanotechnologies — The quasi-periodic excitation of a tunneling junction by a mode-locked ultrafast laser generates a regular sequence of femtosecond pulses of electrons at the pulse repetition rate f_R of the laser to be superimposed on the dc tunneling current. In the frequency domain this is equivalent to a microwave frequency comb (MFC) of harmonics at integer multiples of f_R. Using a metal tip and sample in a scanning tunneling microscope and a mode-locked Ti:Sapphire laser with a f_R of 74.254 MHz, the 200^{th} harmonic at 14.85 GHz has a signal-to-noise ratio of 20 dB, and a linewidth <1 Hz which sets the present state-of-the-art for narrow-linewidth in a microwave source. The decay in the amplitude of the harmonics with increasing frequency corresponds to a time constant of 320 ps which is attributed to 6.4 pF of shunting capacitance near the junction and the 50 Ω load of the spectrum analyzer. Spreading resistance in semiconductor samples causes the measured attenuation to be sensitive to the local concentration of the carriers. The laser photon energy must be less than the bandgap energy to prevent the creation of electron-hole pairs which would cause surge currents that interfere with the measurements.

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