Near-field infrared nanospectroscopy at ELBE

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We combine scattering scanning near-field infrared microscopy (SNIM) with tunable infrared to THz light sources using the linear electron accelerator ELBE (electron linac for beams with high brilliance and low emittance) at the Helmholtz-Center Dresden-Rossendorf, Germany (see Fig. 1).

The free-electron laser at ELBE (FELBE) provides a narrow-band light source range from 4 to 250 µm wavelengths which is used in quasi-cw mode with a repetition rate of 13 MHz [1]. We utilize FELBE in two SNIM-setups, one at ambient conditions and one in a bath cryostate operating down to T≈5 K. These infrared setups are applied to materials analyses e.g. for nanoscopic spectroscopy in complex oxides, low temperature phase transitions, and imaging of structural domains [2-4]. We particularly benefit from the multi-functionality of the AFM-based SNIM that additionally allows for the complementary determination of topography, piezoelectric response, local conductivity, and surface potential measurements of the samples. Furthermore, we explore areas of fundamental optics and metamaterials such as the superlens behavior that allows for sub-diffraction imaging [5-7].

Only recently, the new superradiant THz source TELBE has been installed at ELBE, which extends the accessible wavelength range towards the THz frequency range from 0.1 to 3 THz (100 to 3000 µm wavelength) [8]. These high-field THz pulses will be used in combination with a home-built SNIM in order to study field-driven dynamic processes such as the electron-hole plasma recombination and spin-wave transport. Here, we are particularly interested in combining SNIM with time-resolved methods. To date, we are commissioning the TELBE-SNIM concerning sideband demodulation and pump-probe configurations with different light sources [9].

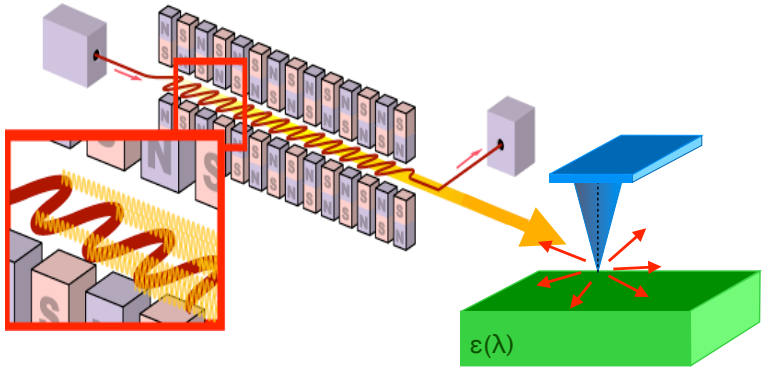

Fig. 1: SNIM setup in combination with the free-electron laser FELBE.

References:

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