Near-field THz nanoscopy with novel accelerator-based photon sources

Lukas M. Eng[1,2], F. Kuschewski[1], J. Döring[1], L. Wehmeier[1], T. Nörenberg[1], Th. de Oliveira[1], H.-G. von Ribbeck[1], D. Lang[3], B. Green[3], S. Kovalev[3], N. Awari[3], S. Winnerl[3], M. Helm[2,3], M. Gensch[3], and S.C. Kehr[1]

[1] *Institute of Applied Physics, School of Science, TU Dresden, 01062 Dresden, Germany*
[2] *Center for Advancing Electronics Dresden – cfaed, TU Dresden, 01062 Dresden, Germany*
[3] *Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, 01328 Dresden, Germany*

Email: lukas.eng@tu-dresden.de

This talk advertises scattering-type scanning near-field infrared nanospectroscopy (s-SNIM) in the spectral range of 75 to 1.3 THz [1], as provided by the free-electron laser **FELBE** at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Germany. The FELBE narrow-band laser-light constitutes one of Germany's accelerator-based laser light sources [2] that sails under the *LEAPS consortium* flag which has recently been established as the "**L**eague of **E**uropean **A**ccelerator-based **P**hoton **S**ources (LEAPS) for advancing IR and X-ray science for next-generation material sciences down to nanometer and molecular length scales.

When combining s-SNIM with FELBE, we demonstrate the λ-independent optical resolution of a few 10 nm only, by exploring structured Au samples, Graphene-transistors, meta-materials [3,4], and local ferroic phase-transitions [5,6,7] down to LHe temperatures [8]. s-SNIM secondly was integrated into a THz pump-probe setup for the inspection of excited states in structured SiGe samples. We developed a sophisticated demodulation technique that extracts pump-induced signals with an excellent signal-to-noise ratio [9]. Thirdly, HZDR recently extended the wavelength range down to 100 GHz radiation employing the novel super-radiant TELBE light source [10]. We adapted our s-SNIM to this TELBE photon source as well, achieving an equally high spatial resolution as with FELBE. Moreover, the superb temporal resolution of TELBE allows us to locally explore a multitude of physical phenomena by s-SNIM with sub-cycle resolution [10,11], such as spin-structures, magnons and phonon polaritons.

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