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Near-field imaging using intense terahertz (THz) pulses

For more than two decades, the great success of terahertz time-domain spectroscopy (THz-TDS) has kept high the enthusiasm of working in this frequency range. Common knowledge from the optics world has rapidly merged with THz applications, providing a unique boost to this promising field. Notably, important breakthroughs in condensed matter physics and time-resolved THz nonlinear optics have been reported. However, one of the clear limitations of the THz applications described thus far is the poor spatial resolution for imaging, for which intensive studies have been conducted to work beyond the diffraction limit. Although near-field THz systems can achieve high spatial resolution, the usual THz near-field microscopes are based on linear effects, however there is great interest on how nonlinear effects induced by THz radiation could be exploited for THz imaging. For a Gaussian beam excitation, nonlinearities may have strong spatial dependences on the field strength. Such features are typically averaged out in the far-field, thus reducing or misinterpreting the local nonlinear effects. One way to circumvent this problem is to access the intense field/matter interactions in the near-field range and time-resolve its 2-dimensional amplitude and phase distributions. Here, we present a recently proposed microscope for real-time THz near- field studies, in which an intense single-cycle THz pulse serves to illuminate a sample deposited on a thin electro optic (EO) sensor for two-dimensional imaging. The key concepts for fast imaging below the diffraction limit will be introduced including the source, the sensor and its applicability for studying novel electro- or magneto-optic sensors.

Biography

François Blanchard has completed his PhD in 2010 from INRS-EMT University, Québec and two Post-doctoral studies from Institute for integrated cell-material science, Kyoto University and in the Physics Department of McGill University. He has joined ÉTS as an Associate Professor in 2015 and recently obtained the ÉTS Research Chair on terahertz (THz) optoelectronic. He has contributed significantly in establishing a world reference in high field THz pulse generation using nonlinear crystals, as well as in developing, in collaboration with Olympus Corp., the first real-time near-field THz microscope.

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