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Wolfgang Kautek

University of Vienna, Austria

Femtosecond laser matter interaction in the optical far and near field

High intensity laser pulses can generate high densities of electrons in matter by avalanche processes and by deterministic multiphoton-electron coupling. The dependence of irreversible modification thresholds on the number of pulses, the so-called incubation, could be quantified by a new model combining the spot size and pulse number dependence of ablation thresholds based on optically active high-density defects with a separation below the laser wavelength. This is successfully demonstrated with organic and inorganic materials. Optical lithography resolution is limited by light diffraction. Apertureless scanning near-field optical lithography (NFOL) can overcome this barrier. There, a scanning probe microscope tip brought down to a few nanometres from a substrate is illuminated by a focused femtosecond laser beam. The laser electromagnetic field is strongly enhanced at the tip-substrate gap, producing modifications on the substrate. Thermal

contributions are discussed on the basis of heat accumulation. Sub-wavelength structuring at the nanoscale is observed, with lateral resolution of about 10 nm and thus surpassing the light diffraction limit.

Speaker Biography

Wolfgang Kautek holds a diploma in chemical engineering from the Vienna University of Technology, Austria, and a doctoral degree from the University of Technology Berlin, Germany. He spent many years, as a research scientist at the University of Kentucky, USA, at the Fritz-Haber-Institute of the Max-Planck-Society, Berlin, at the IBM San Jose Research Laboratory, California, USA, and the Siemens Research Centre, Erlangen, Germany. In 1981, he was awarded the Otto-Hahn-Medal of the Max-Planck-Society. From 1988 until 2004, he was head of the Laboratory for Thin Film Technology of the Federal Institute for Materials Research and Testing, Berlin, Germany. In 2003, Wolfgang Kautek was installed as adjunct professor at the Institute of Chemistry of the Free University Berlin, Germany. In 2004, Wolfgang Kautek followed a call as full-professor for Physical Chemistry at the University of Vienna.

e: wolfgang.kautek@univie.ac.at