
Transient absorption and pump-probe spectrometers with <10 fs resolution

Transient Absorption Spectrometer (TAS) is an instrument for femtosecond pump-probe spectroscopy. TAS incorporates highest quality optics, opto-mechanics, Fourier Transform spectrograph, optical chopper, vibration control, delay-line stage, and easy-to-use LabVIEW™ based software to deliver results. TAS can be upgraded and reconfigured to support many other ultrafast spectroscopy techniques as your research needs evolve.

- Flexibly designed femtosecond pump-probe spectrometer
- Supports a variety of ultrafast laser present at ELI-ALPS
- Broad pump-probe delay range and high pump-probe delay resolution

Technical specification with HR laser **Pump:** Same as HR laser (100 kHz, 1030 nm/515 nm) Probes: white light (CaF₂, Sapphire and LiF), terahertz probe (ZnTe: 0-3 THz GaP: 1-7 THz, 2 color laser induced plasma: 1-40 THz), Time resolution: ~6-10 fs

Technical specification with SYLOS laser **Pump:** (1 kHz, 908 nm/454 nm)+THz pump (~150 kV/cm, @~1 THz) Probes: white light (CaF₂, Sapphire and LiF), terahertz probe (ZnTe: 0-3 THz GaP: 1-7 THz, 2 color laser induced plasma: 1-40 THz), **Time resolution:** ~6 fs

Technical specification with Terahertz pump laser **Pump:** (1 kHz, 908 nm/515 nm)+THz pump(~150 kV/cm, @~1 THz) Probes: white light (CaF₂, Sapphire and LiF), terahertz probe(ZnTe: 0-3 THz GaP: 1-7 THz, 2 color laser induced plasma: 1-40 THz), **Time resolution:** ~6 fs

Fourier Transform Visible to MIR Spectrometer: Bruker Vertex 80: spectral range: 50000-600 cm⁻¹, step scan capable, time resolution: 2.5 ns, synchronizable with 100 kHz or 1 KHz laser system, spectral resolution: 0.06 cm⁻¹

Software: LabVIEW based software (in house developed) to obtain TA measurements+ OPUS software for Vertex 80

Sample: Liquid temperature controlled stirred sample holder, solid sample holder, integrating sphere for solid samples, electrochemical cell for combined TA and electrochemical measurements

Gas phase reaction chamber (GPRC) for pump-probe spectroscopy is an instrument for performing photodissociation experiments and gas phase reactions at low pressures (~1x10⁻⁴ Torr). The chamber incorporates an Even-Lavie valve (Amsterdam Cantilever Piezo

Valve ACPV2/ACPV3) as a source for high intensity supersonic beam (jet cooled molecules, 20 mS gate up to 5 kHz), large capacity turbo molecular pump capable of handling of corrosive gases (STP-IS2207c CF200, 2200 l/s N₂, magnetically levitated, Edwards), pressure gauges, integrated optical breadboard and optics for combining XUV and visible/terahertz pulses, optics for collecting fluorescence of photofragment, fiber optic probe for fluorescence monitoring and motorized vacuum compatible mirror mounts for accurate alignment of pump and probe pulses. Additional ports are also available for mounting e.g. mass spectrometer and various feed through.

Ultrafast spectroelectrochemistry

With a custom-made sample holder and electrochemical cell we can combine electrochemical measurements with the above detailed transient absorption spectroscopy setup to perform UV-vis pump/visible probe **ultrafast spectroelectrochemical measurements**. We can carry out measurements under inert conditions (or different glass inlets) in both aqueous and non-aqueous media on any optically transparent electrode. With the above listed laser parameters, it is possible to probe the effect of applied bias on the generation and annihilation of charge carriers in the electrode material. For further details on the technique please see the following publications:

J. Am. Chem. Soc. 2018, 140, 86–89 and ACS Energy Lett., 2019, 4, 702–708

A further combined setup is under development that uses electrochemistry with optical pump/THz probe spectroscopy. This spectroscopy is sensitive to the mobile and non-mobile nature of charge carriers in semiconductors.

General chemistry laboratory

The chemistry lab at ELI-ALPS is equipped to handle the basic chemical needs of users in terms of sample preparation and quality control. General sample cleaning protocols can be employed using a programmable drying oven, ultrasonic bath and plasma cleaner. More advanced equipment makes it also suited for the preparation of sensitive samples on the spot. An **MBraun glovebox** provides the necessary inert working conditions (oxygen and water free environment). Annealing of prepared samples is also possible until 1200 °C in a **Nabertherm L 5/12** programmable muffle furnace. We are equipped with a **PGSTAT302N** potentiostat/galvanostat, which makes us capable for advanced electrochemical measurements. It is equipped with an electrochemical impedance module and a small current module. We are also able to perform intensity modulated photocurrent spectroscopy (white and blue LED) with the current electrochemical setup.

Technical specifications of PGSTAT302N: Potential range: +/- 10 V, Maximum current: +/- 2 A, Current ranges: 1 A to 10 nA (100 pA with ECD module), Potentiostat bandwidth: 1 MHz, Used software: NOVA