General

The compact optical head #OE-000888 enables terahertz measurements in reflection mode. The device comprises four parabolic mirrors, which generate a focus at the location of the sample and re-focus the reflected beam onto the receiver antenna. The sample should be positioned directly at the output of the measurement head. The incident angle of the terahertz beam on the sample is 8.8 degrees. The focus generated has a diameter of approx. 2.5 mm. The compact head features a connector for tubes with an outer diameter of 6 mm (FESTO - CK-M5-PK-4) for purging the setup with dry air or nitrogen, which helps to remove absorption due to ambient water vapor.

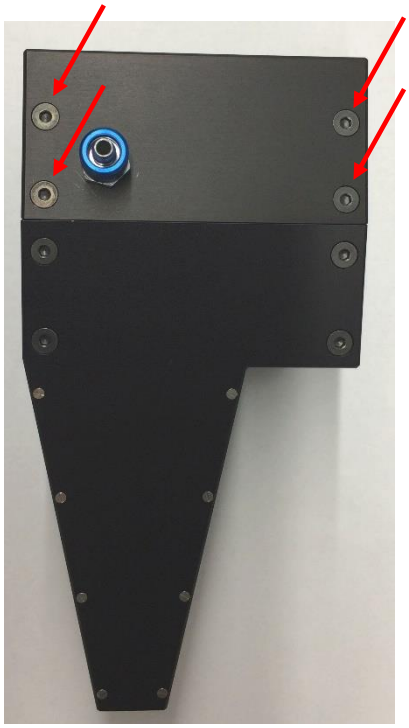

Figure 1: Side view of the measurement head with connector for purging. The screws which remove the cover are marked with red arrows.

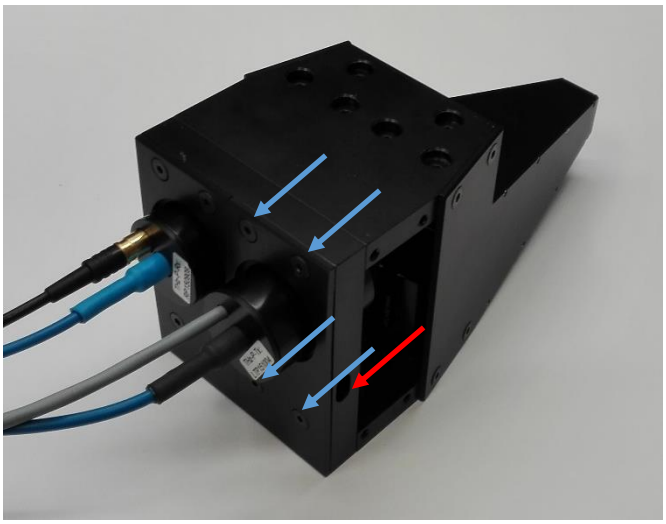

Figure 2: Top view. The screws that adjust the antenna position are indicated with red and blue arrows.

Optical Setup

A schematic of the optical setup is shown in figure 3. Four off-axis parabolic mirrors with a diameter of 1” are used for beam shaping. The two mirrors next to the antennas have a focal length of 2” and the two central mirrors have a focal length of 4”. They are slightly tilted, resulting in an incident angle of the terahertz beam on the sample of 8.8 degrees.

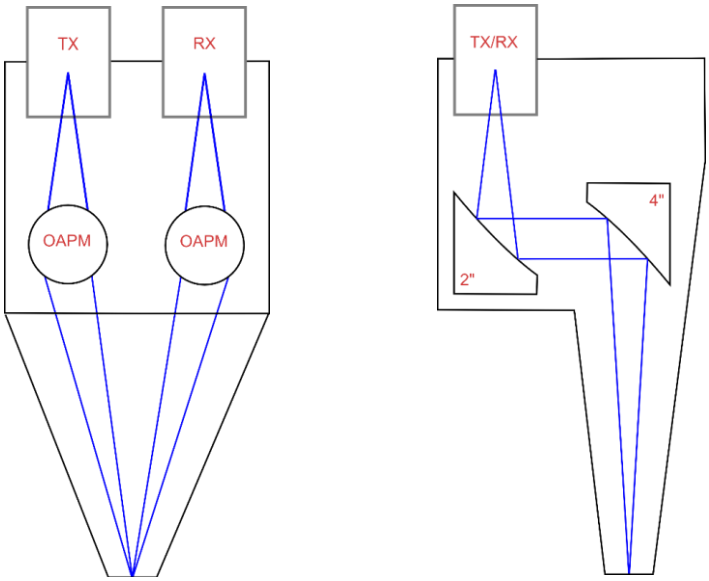

Figure 3: Schematic of the optical setup (left: front view, right: side view). The focal length of the off-axis parabolic mirrors (OAPMs) is indicated.

Installation of the Antennas & Optical Alignment

Remove the small covers on both sides of the unit, using the four screws marked with red arrows in figure 1. The locking screws that fix the antennas in the holder become accessible through a small hole, marked with a red arrow in figure 2.

Place the antennas in the mounts as shown in figure 2. Transmitter and receiver module have to be rotated outwards by ± 8.8 degrees, according to the arrangement of the terahertz beam path. This rotation is easily observable when looking from the module side onto a bright background, see figure 4. Fix the antennas by tightening the locking screws.

Figure 4: Polarization rotation.

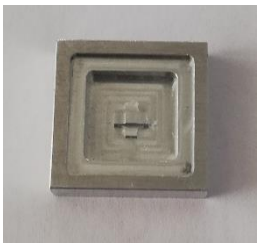

Figure 5: Alignment tool - patterned aluminum reflector.

The mirrors within the reflection measurement head are pre-aligned and fixed. Once the antennas are inserted, the focus position needs to be adjusted. This is done by carefully moving the antennas up and down in their mounts. The rear side of the antenna module should protrude approx. 7 mm from the reflection head. In addition, the horizontal position of the antennas can be adjusted by releasing the four screws around each antenna on the top side of the measurement head (blue arrows in figure 2) and moving the antenna manually. Take care not to change the angular orientation of the antenna modules.

To facilitate the alignment in conjunction with a pulsed terahertz system, TOPTICA provides an alignment tool (patterned aluminum reflector, see figure 5). It consists of 5 sections, all of which have a size of 1.5 x 1.5 mm^2, but different heights. Placed underneath the measurement head the reflector generates several pulse “echoes”, visible at different times in the pulse trace. The first peak comes from the central section and has to be the largest one. The following 4 reflexes result from off-centered light along the x- and y-axis. They should exhibit similar amplitudes, but be small compared to the central pulse. The sixth, somewhat broader pulse originates from the large background area. Figure 5 shows an example of a pulse trace for a well-aligned measurement head.

For the alignment with a continuous-wave terahertz system, the patterned aluminum reflector is less suitable. For a basic alignment, we recommend a flat metal reflector (e.g. the rear side of the alignment tool). To make sure the beam is correctly centered, a small flat metal reflector (e.g. a circle of aluminum foil with approx. 5 mm diameter) on a foam substrate can be used.

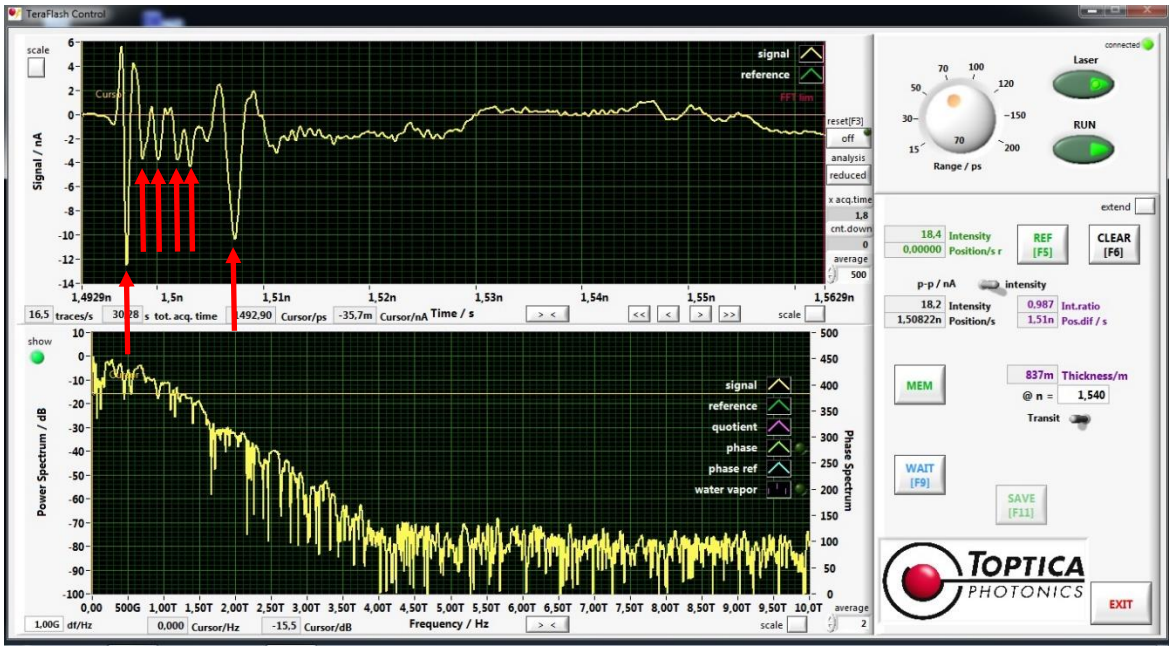

Figure 5: Pulse trace acquired with reflection head and aluminum adjustment tool. The 6 pulse generated are marked by red arrows, their shape indicates a good central adjustment.