

Reflective Terahertz Imaging at the ENEA FEL Laboratory

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THz radiation penetrates most dielectric materials and is specifically absorbed by organic substances. As in the case of microwaves metals are completely opaque to THz radiation, and polar liquids such as water are strong absorbers. The absorption and reflection properties of water in the THz region make possible new applications of THz radiation for monitoring the hydration state of plants on a laboratory scale as well as on the field. Moreover, unlike microwaves, focusing a THz beam to a submillimeter spot is straightforward. All such properties make THz radiation a powerful tool to provide high contrast in imaging applications in environmental studies.

The development of both transmissive and reflective THz imaging is under way at ENEA-Frascati employing a THz Compact Free Electron Laser (THz C-FEL). This source provides 130 GHz coherent radiation with an output power of 1.5 kW in 4 μ s pulses at a maximum pulse repetition rate of 10 Hz. The high peak power available makes the FEL particularly suitable for long range detection. Different setups have been tested at different levels of spatial resolution to image objects from a few centimeter square to larger sizes. In this paper we demonstrate an example of reflection imaging. Using a hybrid setup in reflection we have obtained 0.4 mm spatial resolution at 130 GHz: the FEL radiation is coupled first into a focusing cone and then into a WR6 directional coupler. The reflected signal is detected by a diode with 14 dB attenuation. Images of different samples will be presented together with considerations on how to optimize the contrast and the maximum achievable resolution.