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Title

Observation of water trees using terahertz spectroscopy and time-domain imaging

Source

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Abstract

Terahertz measurements were carried out to detect water trees grown in low-density polyethylene sheets. Water absorbs light at terahertz frequencies, fairly strongly at about 5.0 THz and rather weakly from 0.1 to 1.0 THz. Using the absorption at these frequencies, observation of water trees was tried according to the following procedures. First, we made a model sample, consisting of a polyethylene sheet, a water layer, and a copper plate, and terahertz light was irradiated to this sample vertically. The waveform and intensity of electric field of the terahertz light reflected by the sample clearly pointed out the presence of water layer beneath the polyethylene sheet by the reflection peak appearance time and the phase of reflected electric field. Secondly, water trees were grown in a polyethylene sheet, and terahertz light was scanned over the sheet. As a result, the intensity distribution of terahertz light reflected by the sample was in good agreement with the shape of the water trees. Observation of terahertz image was also carried out using the same polyethylene sheet with water trees over which a polyvinyl chloride sheet or a carbon-loaded polyethylene sheet was put to simulate the structure of a real cable. An image of water trees was also successfully observed. These results indicate that the terahertz spectroscopy can be a new characterization tool to observe the presence of water trees in a test sample taken from an aged cable. (21 References).