Frequency-comb-referenced high-precision THz sources for high-resolution THz spectroscopy and non-destructive thickness profile measurement

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Terahertz (THz) radiation, a segment of the electromagnetic spectrum lying between microwave and infrared frequencies, offers novel solutions for the non-destructive measurement and inspection of semiconductor and secondary battery electrodes. The unique properties of THz waves, with their ability to penetrate various materials while providing valuable insights into their composition, make them instrumental in quality assessment. Its non-invasive nature also allows for thorough inspection without altering the structural integrity of the materials. To realize the full potential of THz-based measurements, both the time-domain and frequency-domain characteristics of THz sources require high-precision referencing to established time/frequency standards. This referencing process is pivotal for ensuring the accuracy and reliability of measurements. Femtosecond laser frequency combs, recognized by the 2005 Nobel Prize in Physics, enable the precise manipulation of THz waves, facilitating the enhancement of THz measurement precision to sub-micrometer or even nanometer levels. Highly precise terahertz spectroscopy defined by the frequency comb enables us to measure the physical properties and geometry of the tested object with exceptional accuracy. Frequency-comb-referenced high-precision THz sources accompanied with various strategies show high potential in characterizing non-conductive materials without destruction. This technological synergy not only elevates the precision of THz measurements but also opens new avenues for advancements in material science, electronics, 6G communications and beyond.