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SCHOTTKY DIODE DETECTORS FOR MONITORING COHERENT THZ SYNCHROTRON RADIATION PULSES*

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Abstract

Examination of the wideband zero-bias Schottky diode detector as an instrument for monitoring synchrotron radiation delivers the intrinsic diode response time to terahertz synchrotron radiation of less than 6 ps along with the three orders of magnitude dynamic range and a noise equivalent power of 10 pW $Hz^{-1/2}$. This allows one to control simultaneously the spectrum and the stability of the amplitude and duration of single-bunch pulses of the coherent THz synchrotron radiation.

INTRODUCTION

Coherent synchrotron radiation (CSR) in the terahertz (THz) frequency range from electron storage rings is a powerful tool for user application and diagnostics of the electron-beam. The emission spectrum and pulse duration of the THz CSR depends sensitive on the shape and size of the electron bunch from which the radiation is emitted [1]. On the other hand, extremely high brilliance promotes CSR to a powerful source for spectroscopy in the terahertz frequency range [2]. The ultimate spectral resolution of this technique depends on the stability of the source radiation. Among available direct THz detectors only superconducting micro-bolometers [3, 4] and Schottky diodes [5] are capable to resolve CSR pulses from adjacent electron bunches. Here we present recent photoresponse measurements of CSR with a quasioptical zero-bias Schottky diode detector which was produced at ACST GmbH.

SCHOTTKY DIODE DETECTORS

The zero-bias Schottky diodes with different monolithically-integrated broad band planar antennas are fabricated using thin-film process [6]. Diodes were mounted on the rear side of a 6-mm (radius) lens from silicon with large room-temperature resistivity and packaged into the standard detector modules. Modules contain either low-noise amplifiers for moderate signal modulations (DC to 2 MHz) or a microwave (0.1 to 6 GHz) amplifiers. Alternatively, the diode can be directly connected to the outer connector of the module by means of the ultra-wideband transmission line. The detector modules with different amplifiers are shown in Figure 1. Typical spectral sensitivity of the zero-bias Schottky diode detector (SDD) without an amplifier is shown in Figure 2. The spectrum was obtained with the Fourier transform spectroscopy (FTS) and normalized to the spectral sensitivity of a Golay Cell detector which was measured with the same FTS instrument.

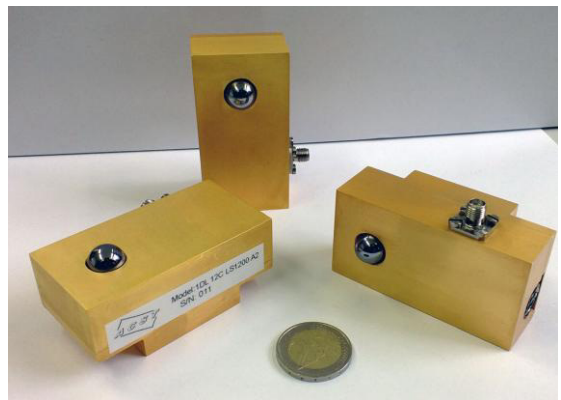

Figure 1: A photograph with commercially-available standard Schottky diode detector modules incorporating the detector and different amplifiers.

CSR RESULTS

The Physikalisch-Technische Bundesanstalt (PTB), the German national metrology institute is operating the low-energy electron storage ring Metrology Light Source

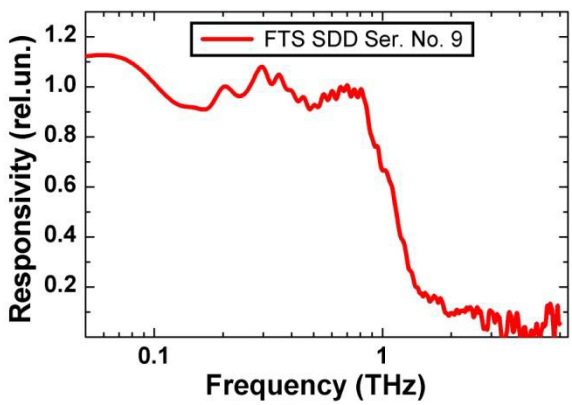

Figure 2: FTS spectral sensitivity of the typical ´Schottky diode without an amplifier. It was normalized to the spectral sensitivity of a Golay Cell detector.

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