Introduction

A Glow discharge detector (GDD), based on a commercial neon lamp, was used in a continuous wave (CW) terahertz (THz) imaging system. The responsivity and noise equivalent power (NEP) of a GDD are 70 V/W and $1.26 \times 10^{-6}$ W/Hz$^{1/2}$, respectively. The performance of the GDD can be improved as commercial neon lamps do not have an optimized structure as a THz detector. The preliminary results indicate that a well-designed GDD will be an excellent THz detector with microsecond response time, wide spectral range (0.1 ~ 10 THz), high responsivity (~ 1000 V/W) and low NEP (< $10^{-12}$ W/Hz$^{1/2}$).

Glow Discharge Detector

A GDD is a commercial neon lamp filled with low pressure inert gases with Penning mixture and typically coated with phosphor. Two electrodes are placed parallel within the lamp, which ionize the inert gases, resulting in discharge current. The incident THz wave enhances ionizing collisions of electrons with neutral atoms and causes an increase in the discharge current.

- Low cost (less than $1)
- Electronic ruggedness
- Broad spectral range (MW, IR, UV)
- Room-temperature operation
- Fast response speed (microsecond rise time)

Responsivity and NEP of GDD

Responsivity (Gain: 130)

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NEP = \sqrt{\frac{\text{noise power spectral density}}{\text{responsivity}}}
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when
- discharge current of GDD is 8.8 mA
- chopping frequency is 900 Hz

Deficient NEP caused by:
- Absorption of glass wall
- Scattering of glass wall
- Mismatch between THz beam size and gap size of GDD

References


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