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Response to Review 3

In this work, the authors proposed a new scheme for broadband terahertz detection by laser-gas interaction without high voltage manipulation, by using controlled optical bias and balanced geometry. The main advantages of their proposed scheme are that the common noise is reduced, and at the same time the dynamic range and the signal-to-noise ratio are doubled, as compared with the conventional optical bias scheme. So, this work is practically helpful for miniaturization and integration of terahertz time-domain spectroscopy. I would like to recommend the work for publication, provided that the following concerns are addressed:

Q1. It is well-known that refractive-index sensors based on surface plasmon resonances in metal nanostructures are promising in label-free biomedical detection, and many works has been published, such as Nanotechnology 32(46), 465202 (2021) and J. Lightwave Technol. 39(2), 562-565 (2021). I wonder the new scheme proposed in this manuscript whether or not has potential in label-free biomedical detection? And what are the advantages of the proposed scheme, as compared with well-known refractive-index sensors?

A1. Thanks for your suggestion. As your point out, label-free biomedical detection has been one of the important applications for THz time-domain spectroscopy.

We have proposed a gas-based THz detection scheme with broad bandwidth covering from 0.5 to 30 THz. In addition, the scheme is compact without a high voltage source or electrodes. The size further will be reduced if avalanche phototubes are used instead of photo-multiplier tubes, which makes it possible to integrate the whole detection module into a bundled assembly.

Based on the ultra-wideband, high signal-to-noise ratio, and integrated THz time domain detection system, we believe it will be able to be applied to label-free biomedical detection in the THz band.

Compared with the refractive index sensors, the THz time-domain spectroscopy based on the new detection scheme will obtain complex refractive indexes of label-free specimens in the wider spectra without Kramers-Kronig transformation.