GeSn Plasmonic Terahertz Photoconductive Antenna

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I. Motivation & Introduction

Conventional photoconductive materials are mainly based on low-temperature-grown or metal-doped III-V materials, which requires precise control of epitaxial condition to obtain high-quality structure and thus hard to be mass-produced and fully commercialized [1]. To address this problem, we demonstrate a plasmonic terahertz photoconductive antenna (PCA) based on thermal evaporated GeSn photoconductor.

Reference


II. Design

- The Raman spectroscopy shows the crystal quality of thermal evaporated GeSn thin film annealed at 400°C comparing with that of bulk Ge. (Quality can be further improved !)
- The plasmonic gratings - 230 nm spacing, 480 nm pitch, and 5 nm/45 nm Cr/Au covering 20 × 20 µm² active area - are then deposited on the GeSn thin film to enhance the light-matter interaction resulting in efficient terahertz radiation [2].

III. Experimental Setup

The GeSn plasmonic PCA is pumped with a femtosecond fiber laser with a central wavelength of 1560 nm, 60 fs pulse width, and repetition rate of 100 MHz. The radiated terahertz electric field is measured by an asynchronous optical sampling (ASOPS) system, allowing high-speed scanning without using a mechanical delay line (usually 10 ms per pulse!).

IV. Result

- (a) The time-domain THz signal with FWHM of 839 fs is measured by time-domain spectroscopy system.
- (b) The power spectrum of THz radiation, providing SNR 50 dB.

V. Summary

We demonstrated a GeSn plasmonic THz photoconductive antenna performing bandwidth up to 2 THz with SNR 50 dB. It provides fully integrated capabilities with Si CMOS technology, fiber-optics industry, and Si photonics platform. Our experiment demonstrates that GeSn can serve as a highly potential photoconductive material comparing with Ge, making a giant stride toward on-chip THz systems and significantly extending their application fields.