Temperature Dependent Time-Domain Terahertz Spectroscopy of Pure and Nitrogen-Doped Graphene


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Graphene Background

- Single layer of carbon atoms
- Zero-gap semiconductor
- Exceptional ballistic transport properties
- High strength
- High thermal conductivity

Observe the low energy carrier dynamics of graphene
- Understand the effects of doping on the transmittance
- Understand the effects of temperature on the transmittance
- Explain transmission trends within the Mikhailov theoretical model

Experimental Setup: THz-TDS

- CVD on Copper film
- N-doped produced by introducing ammonia
- Transferred to sapphire substrate
- Used THz-TDS to get waveforms
- Compared substrate and sample
- Applied FFT to find transmittance

Doping and Temperature Effects

- Doping increases intraband absorbance
- Temperature broadens the zero-frequency peak of the intraband conductivity

Purpose

- Production of samples
- Use THz-TDS to get waveforms
- Compared substrate and sample
- Applied FFT to find transmittance

Methods

- Terahertz Time-Domain Spectroscopy (THz-TDS) is a method of determining a number of material properties including:
  - refractive index
  - dielectric constant
  - Transmission coefficient
- Production of samples
  - CVD on Copper film
  - N-doped produced by introducing ammonia
  - Transferred to sapphire substrate
- Measurement and Analysis
  - Used THz-TDS to get waveforms
  - Compared substrate and sample
  - Applied FFT to find transmittance

Discussion

Conclusions

- Pure graphene has a higher transmittance than doped graphene in the range of .5 – 2.5 THz
- Around .7 THz, there is a peak that may be attributed to absorbance
- Both pure and doped have very high transmittance