Optical Enhancement in Periodic Plasmonic Gratings for SERS and Metal-Semiconductor-Metal Photodetectors (MSM-PDs) applications

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Background/Relevance

- Free electrons in metallic structures receiving an incident electric field have been shown to exhibit collective oscillations and produce increased electromagnetic fields (i.e. plasmons).
- Deposition of metallic nanostructures on a semiconducting substrate allow for generation of greater photocurrent in the device.

Innovation

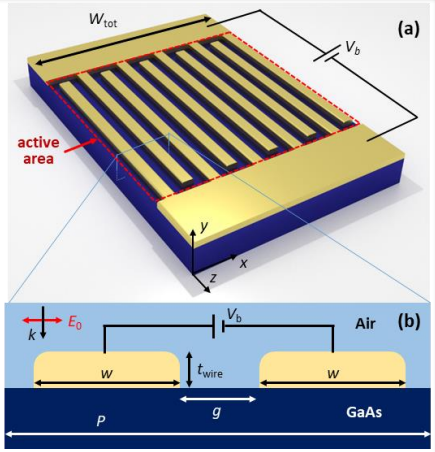
- Enhanced structure design and accurate nanofabrication techniques will lead to greatly improved photovoltaic and photo-detection applications.

Approach

- Generate air/GaAs models in COMSOL FEM software for nano-scale devices.
- Develop script in MATLAB to calculate and plot optical enhancement given raw data from COMSOL.
- Perform various parametric sweeps to vary structural aspects of the structure.

Key Results

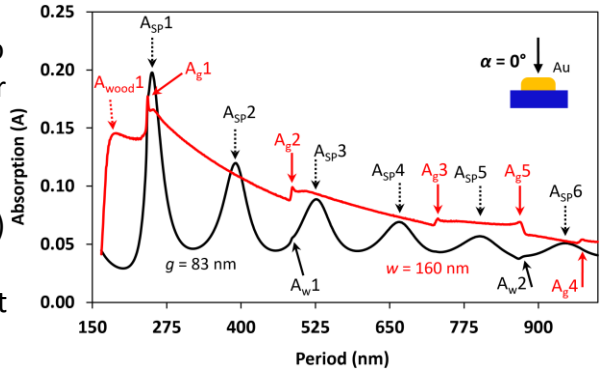
- Demonstrated computationally that a reduction in the gap between structures will generate an increase in optical enhancement due to plasmonic effects.
- Determining a weighted relationship between the optical enhancement and current density.



Darweesh et al, IEEE, JLT. (2018)

Conclusions

- Smaller nano-gap (*g*) between structures increases the optical enhancement produced.
- Period as a function to space can give sharper absorption spectrum.
- Smaller wire width (*w*) and gap space (*g*) generate more current density



Darweesh et al, IEEE, JLT. (2018) & MDPI, nanomaterials. (2018)