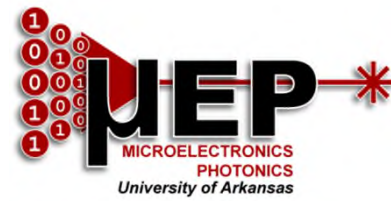




Structural Characteristics of Au-GaAs Nanostructures for Increased Plasmonic Enhancement



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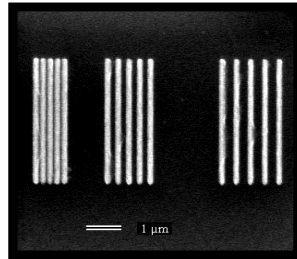
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Background/Relevance

- 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 micro/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 photodetection applications.



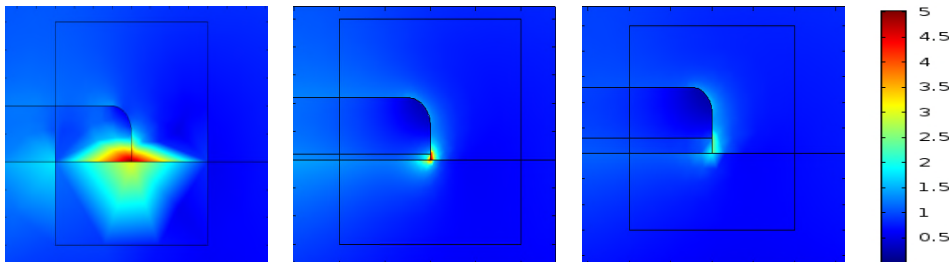
SEM Images of Nanowire Array (S. Bauman)

Approach

- Generate Au/GaAs models in COMSOL FDTD software for nanoscale and microscale devices.
- Develop script in MATLAB to calculate and plot optical flux and photocurrent given raw data from COMSOL.
- Perform various parametric sweeps to vary structural aspects of the structure.
- Analyze and compare results to experimental data and publications involving similar structures.

Key Results

- Demonstrated computationally that a reduction in the gap between structures will generate an increase in optical enhancement due to plasmonic effects.
- Verified with experimental data that reduction of the thickness of both Au and Ti will generate more optical enhancement in the GaAs substrate.



Enhancement in GaAs to due reduction of Ti adhesion layer

Conclusions

- Smaller nanogaps between structures increases the optical enhancement produced.
- Complete removal of the Ti layer significantly increases device performance
- Decreasing the thickness of the Au layer increases photocurrent produced in the GaAs

