Xie, Z., Ramakrishnam Raju, M. V., Adhihetty, P. K., Fu, X.-A., & Nantz, M. H. (2020). Effect of thiol molecular structure on the sensitivity of gold nanoparticle-based chemiresistors toward carbonyl compounds. *Sensors*, *20*(24), 7024. https://doi.org/10.3390/s20247024

## Definitions

- **Thiol Ligands**: Molecules containing sulfur that bind to gold nanoparticles.
- **Gold Nanoparticles (AuNPs)**: Tiny gold particles used in sensors.
- **Chemiresistors**: Sensors that change their electrical resistance when they detect a chemical.
- **Carbonyl Compounds**: Chemicals that contain a carbon-oxygen double bond, like acetone.

## Key Findings

- Thiol molecular structure significantly affects the sensitivity of gold nanoparticle sensors.
- Sensors with dialkyl urea-functionalized thiols showed the highest sensitivity to acetone.
- Sensors with t-butyl end groups were the most effective for detecting acetone, outperforming those with other end groups.

## Introduction

This study explores how the structure of thiol ligands affects the performance of gold nanoparticle-based sensors. These sensors detect carbonyl compounds in the air, which are important for environmental monitoring.

## Main Content

### Background

Gold nanoparticles are used in various applications, including sensors for detecting volatile organic compounds (VOCs). The sensitivity and selectivity of these sensors depend on the molecular structure of the thiol ligands attached to the nanoparticles. This study focuses on understanding how different thiol structures influence sensor performance.

### Methods

- **Materials**: Various chemicals and compounds were used to synthesize different thiol ligands.
- **Thiol Ligand Syntheses**: Three series of thiol-urea ligands were synthesized with different end groups.
- **Thiol-Functionalized AuNP Synthesis**: Gold nanoparticles were coated with the synthesized thiol ligands.

- **Sensor Fabrication**: Sensors were made by coating interdigitated electrodes with the thiol-functionalized gold nanoparticles.
- **Sensor Measurements**: The sensors were tested for their response to acetone and other carbonyl compounds.

**Results**

- Sensors with dialkyl urea ligands (Series II) had the highest sensitivity to acetone.
- Among the dialkyl urea sensors, those with t-butyl end groups showed the best performance.
- The t-butyl dialkyl urea sensor was also more selective for acetone compared to ethanol, water, and benzene.

## Conclusion

The study shows that the molecular structure of thiol ligands plays a crucial role in the performance of gold nanoparticle-based sensors. Specifically, sensors with dialkyl urea ligands and t-butyl end groups provide the highest sensitivity and selectivity for detecting acetone. These findings could help in designing more effective sensors for environmental monitoring.

Word Count: 332