Enhance the stability and precision of the molecular chip measurement system

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Abstract

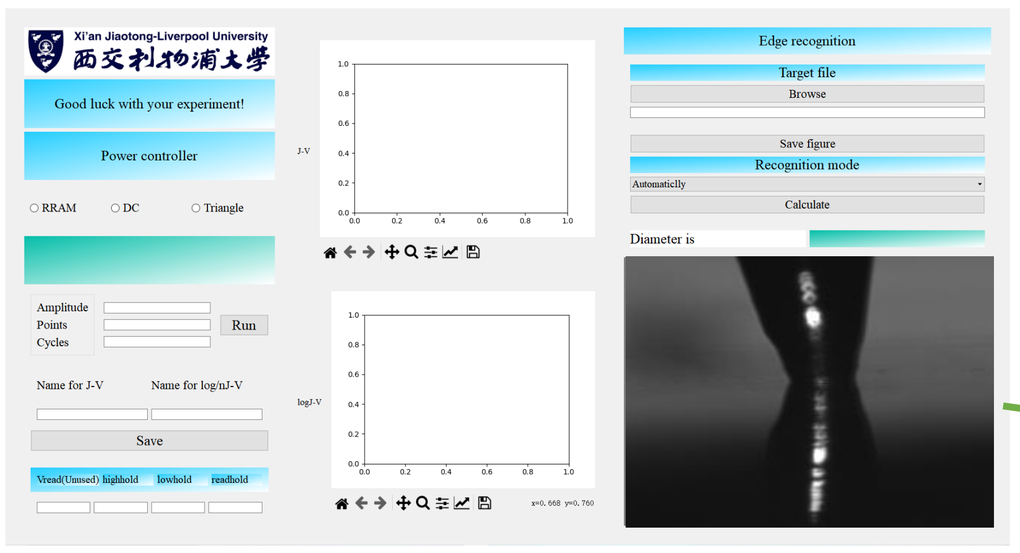
The Self-assembled Monolayer (SAM), an ordered organic molecular layer adhered to a substrate via spontaneous covalent bonding, holds promising potential for crafting monomolecular insulator films, nano-scale electronics, batteries, and more. Our research focuses on the 'EGaIn' method, utilizing Eutectic Gallium-Indium (EGaIn), a liquid metal alloy with properties including fluidity, high conductivity, stretchability, and self-healing capabilities, near room temperature.

In our study, SAMs samples were assembled by co-adsorption of 11-(ferrocenyl)-undecanethiol (FUT80%), and 1-decanethiol (C10-SH20%) on a gold surface, and by pure 11-(ferrocenyl)-undecanethiol (FUT100%) on a gold surface. The data and graphical representation were generated using a Python-based software system for the required measurements.

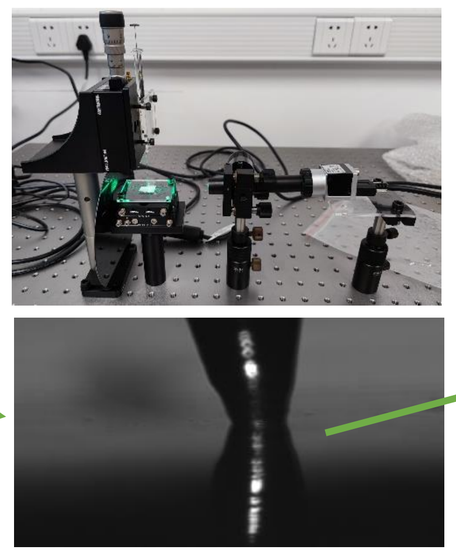
The following sections will elucidate the experimental procedure, data, and advancements in enhancing system scalability, camera sensitivity, code separability, and SAM function stability. Special emphasis will be placed on the software system's role and improvements.

System Overview

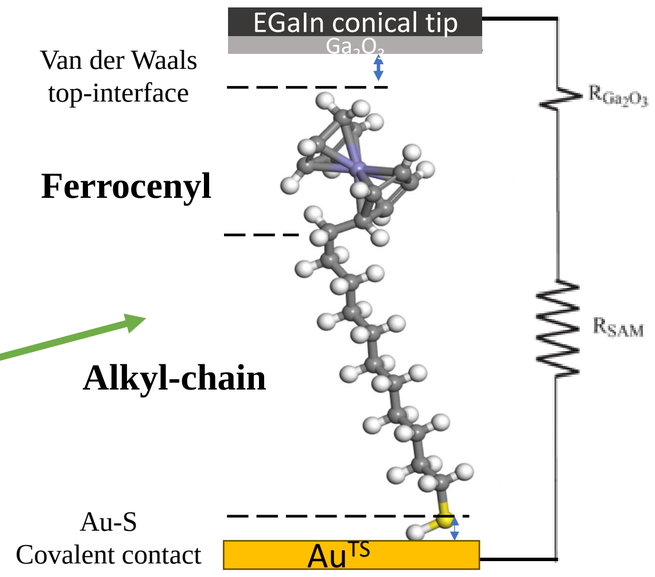
System User Interface



EGaIn System & Optical Image



Molecular Junction



The junction micrograph

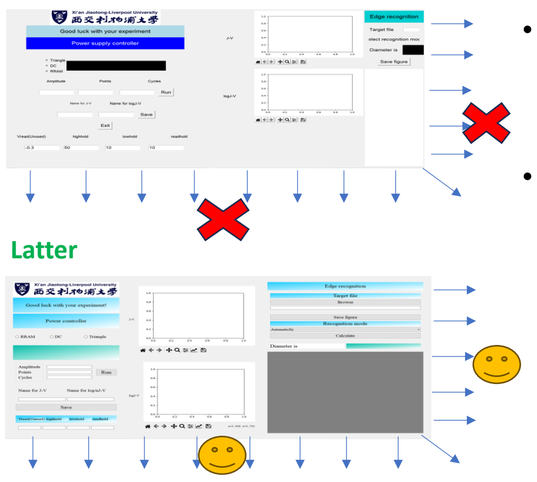
Improvement of System

Enhance the performance of the molecular measurement

Enhancement of Measurement

Scalability

Former



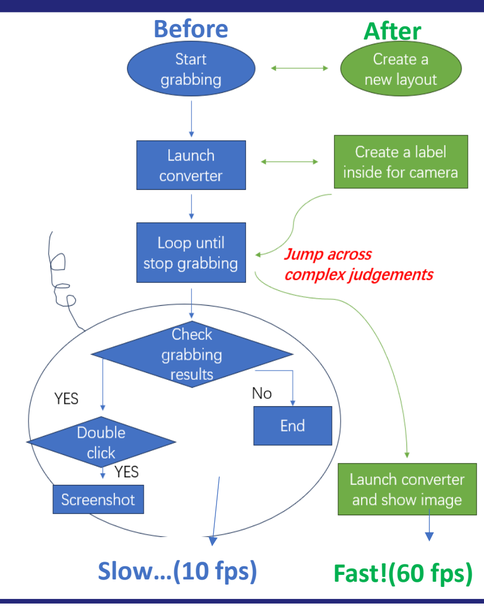
- Before, the interface was unable to scale proportionally, which often led to a distorted appearance on different screen sizes.
- After The use of PyQt5 and QT Designer has allowed the interface to be scalable, enabling it to adapt seamlessly to displays of varying sizes.

Latter

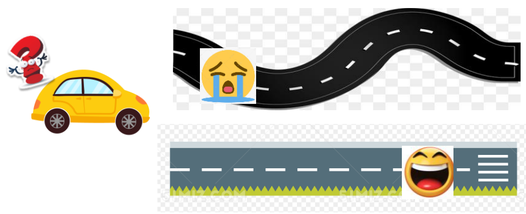
TKINTER GUI FOR PYTHON

Code less. Create more. Deploy everywhere.

Sensitivity of camera



- The previous camera function had noticeable latency (only around 10 frames per second)due to the extensive operations performed on each frame.
- Contrastingly, the improved function has significantly reduced this lag by creating a new layout for displaying the camera's image and using a timer to regularly update the image (around 60 frames per second).



Separability

Feature	tkinter	pyqt
Code separation	✗	✓
Signal and slot	✗	✓
Platform API	✗	✓
UI component	✗	✓

Before...

After!

- **Previous Programming Style (Based on Tkinter):**
- In this style, all window definitions and functional logic are contained within a single file or a tightly interconnected set of files
- **Current Programming Style (Based on PyQt):**
- a more modularized and separated layout.
- Functional logic is implemented in another separate .py file, which calls the .ui file.

Acknowledge

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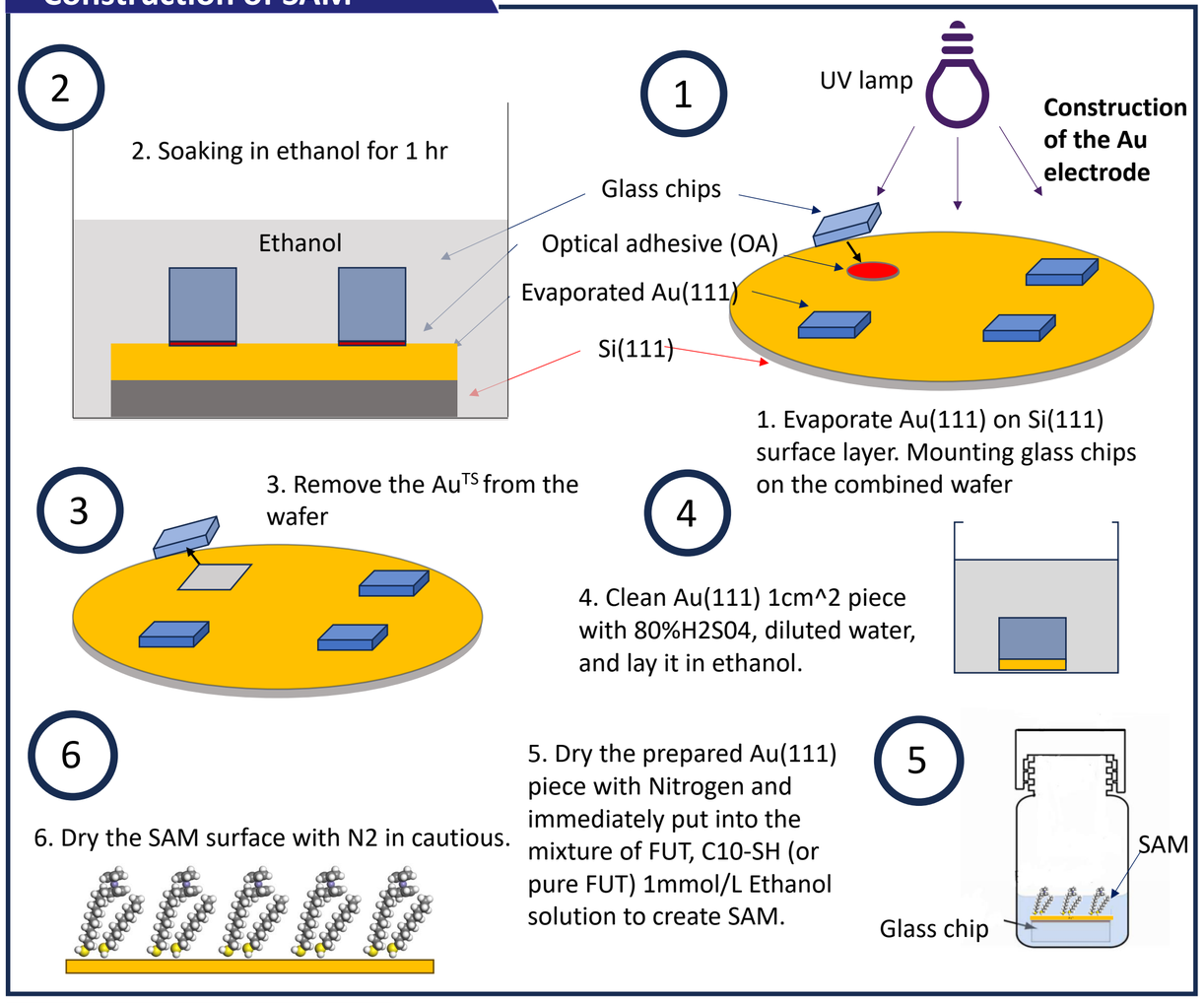
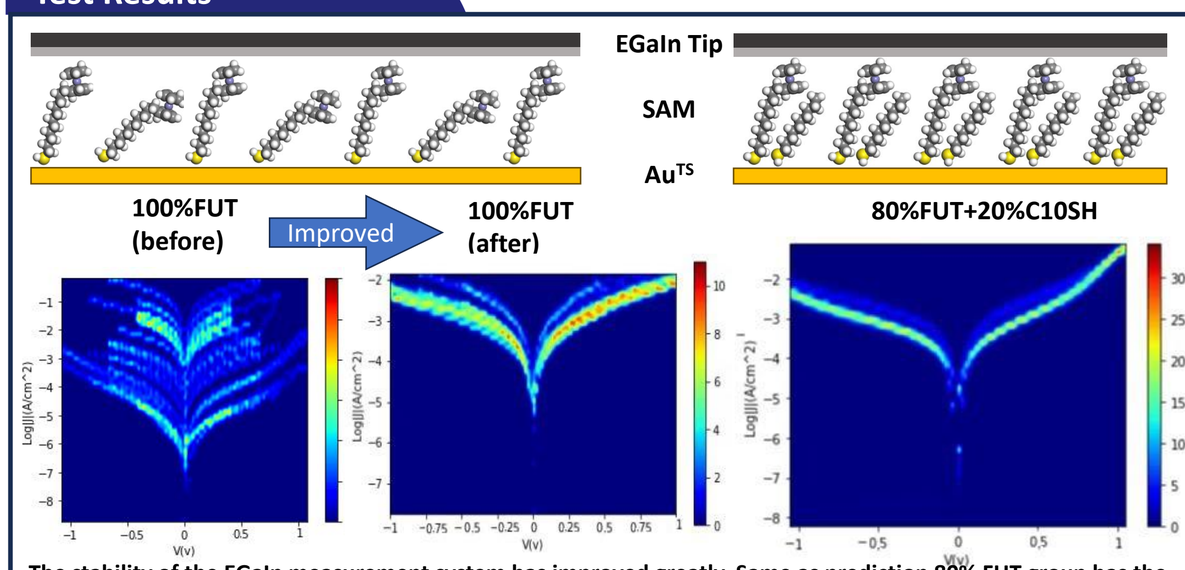
Reference

Ziyan, Wang., Khalid, H., Baili, Li., Yao, Li., Xi, Yu., and Wenping, Hu. (2019) 'Tuning Rectification Properties of Molecular Electronic Devices by Mixed Monolayer', Acta Chimica Sinica, 77, pp. 1031-1035. doi: 10.6023/A19050192

Construction of SAM



Test Results



The stability of the EGaIn measurement system has improved greatly. Same as prediction 80% FUT group has the best rectification ratio.

	100%FUT (before)	100%FUT (current)	80%FUT+20%C10SH
Rectification ratio	N/A	1.42	99.94

Conclusion

In this project, we have improved the measurement software and the EGaIn system by improving the system scalability, camera sensitivity and code separability. To test the enhancement of the system, we have done molecular test using two concentration of FUT, 100%FUT and 80%FUT t to construct SAM. Due to the improvement of the testing system and the enhancement of construction technique, the rectification ratio have increased significantly. In the future, we are going to work on a more stable and accurate testing system.