

Introduction

The intercalation of silver ions into DNA occurs via non-canonical base pairing with cytosine-cytosine mismatches. We present a characterization of these duplexes through the following methods:

- Immobilization onto HOPG for SEM imaging in preparation for further analysis with an ultra high vacuum scanning probe microscope
- DC thin film conductivity tests under varying humidity conditions
- STM break-junction measurements



Imaging Analysis

- Immobilization onto HOPG via induced dipoles

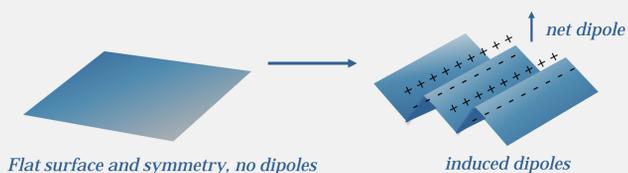


Fig. 1- Induced dipoles in HOPG crinkles caused by flexoelectric redistribution of electron clouds

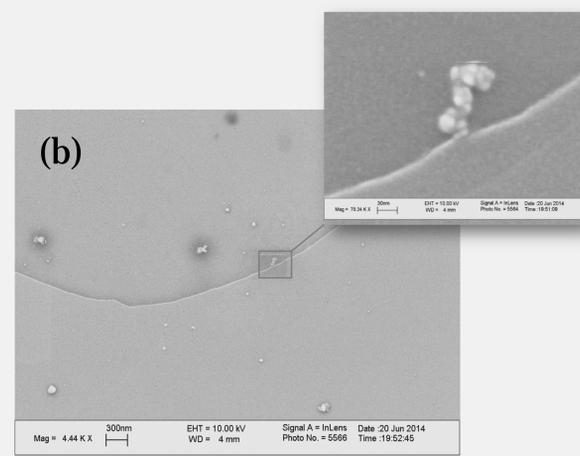
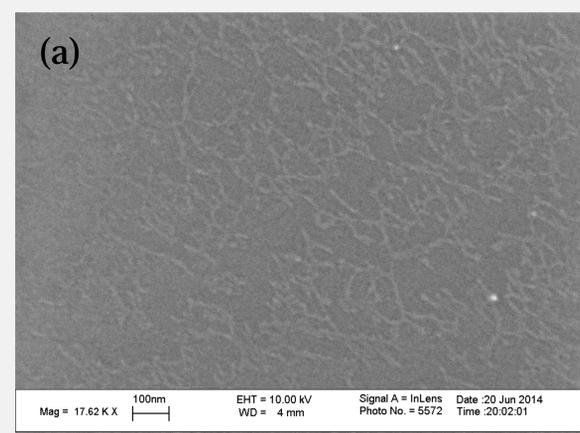


Fig. 2- SEM images of a) large-scale HOPG surface b) HOPG crinkle with immobilized cluster of molecules.

STM Break-Junction Methods

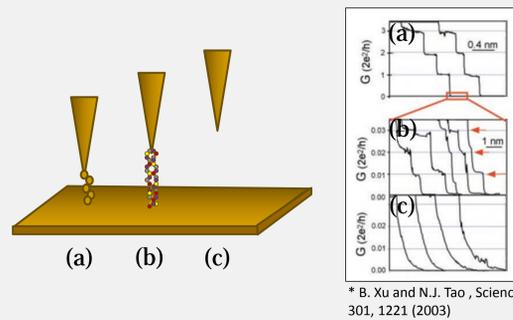


Fig. 5- Phases of tip-substrate interactions and corresponding conductance curves from literature*: a) gold molecular bridge b) single molecule bridge c) complete break of contact.

Thin Film Conductivity

- DC conductivity measurements of dried sample droplet at varying humidity conditions

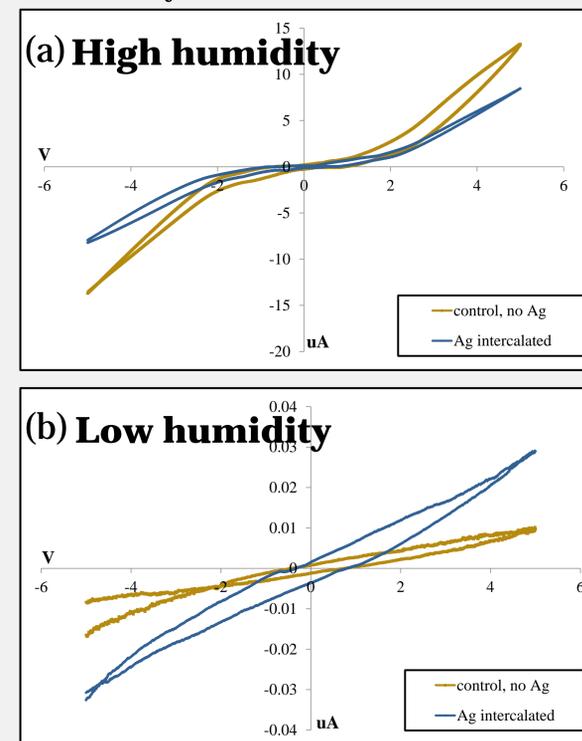


Fig. 3- DC measurements of sample droplet a) without dry nitrogen stream b) with dry nitrogen stream. Stream is used to dissipate humidity.

Best Results

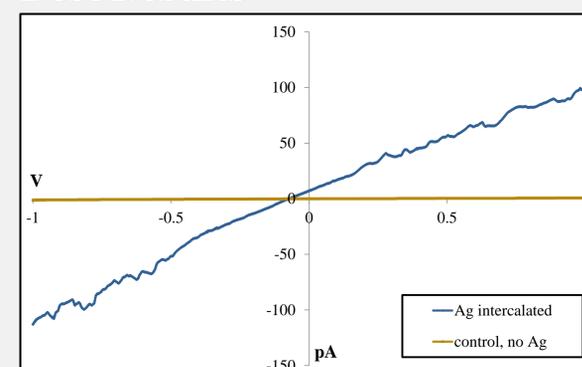
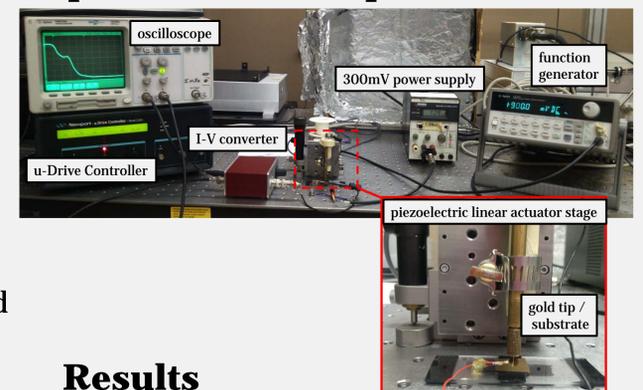


Fig. 4- DC measurements in low humidity conditions show intercalated DNA is roughly two orders of magnitude more conductive than the control sequence.

Experimental Setup



Results

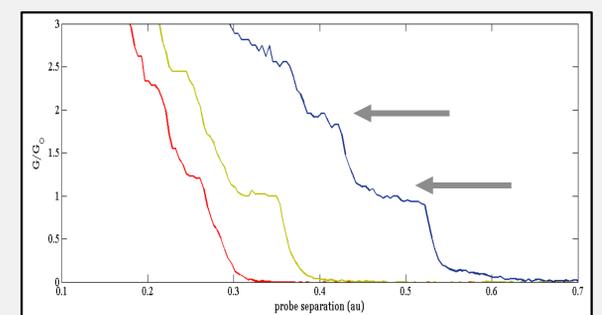


Fig. 6 - Tip-substrate conductance as the tip is pulled away from the substrate. Steps at integer multiples of G_0 correspond to breaking of the gold molecular bridges.

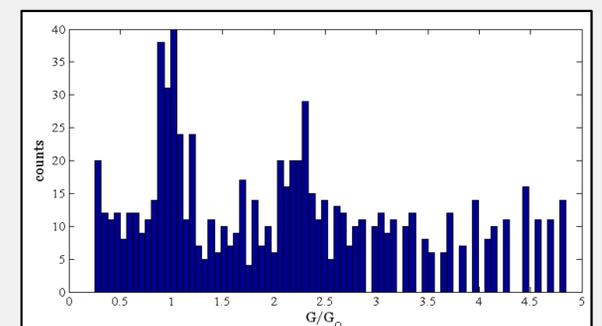


Fig. 7 - Histogram including hundreds of scans like those in Figure 6 confirms clustering of conductivity near multiples of $G=G_0$ and $G=2G_0$.

Near-future goals

- 1 - Improve setup to increase sensitivity and reduce noise;
- 2 - Functionalize DNA to ensure binding to the probe tip and substrate/DNA bridge formation;
- 3 - Obtain conductivity data for single DNA molecules with and without silver.

Conclusion

- Humidity proved to greatly affect DC thin film conductivity readings for both the control and the sample of interest.
- In low humidity conditions, the intercalated sample was roughly two orders of magnitude more conductive than the control.
- Early tests of tip-substrate conductance using the STM break-junction method confirmed conductivity of gold atom chains near multiples of G_0 .

Acknowledgements

I would like to thank the Karen T. Romer Undergraduate Teaching and Research Awards for funding support, and Professor Xu and Dr. Gustavo Fernandes for their guidance and mentorship during the course of this research.

