Paper Summary Format

- Include title of paper, along with publishing information (see example)
- Email summaries to your supervisor
- Include copy of paper in your email

Summary:

- A quick description of the paper and its results/experimental procedures
- Do not *discuss* the results, only summarize

Insight:

- Discuss the results/procedures and how they are exciting
- Answer the question: Why was this paper published?
- You can also include if you do not agree with any of the results, or methods

Application to Research:

- How do the results/procedures apply to your project
- What do you take away from the paper?
- How does it help you?

EXAMPLE:

Imaging local electronic corrugations and doped regions in graphene. Nature Communications. **2,** 372 (2011)

Summary

This paper shows the results on the study of local changes in unoccupied density of states (UDOS) using scanning transmission X-ray microscopy (STXM). The STXM measurements were taken at the 10ID-1 beamline at the CLS. C-1s NEAFS data was taken at Beamline 7 at the ALS. The authors also performed DFT calculations to back up their experimental results. What the authors found was that there are areas in the graphene sheet where the UDOS changes due to rippling of the graphene sheet. This was already expected, but this gives experimental proof. The proof comes from the modulation of the π^* peak intensity, topographically. If the sheet was pristine, the π^* intensity would remain unchanged, but there is obvious modulation. Along with the STXM measurements, the NEXAFS measurements provide new information about the pre-edge and 'interlayer' states. As discussed a couple weeks ago, the interlayer states' origins are in contention. The paper here provides data to suggest the interlayer states come from adsorbents on the graphene surface. To see if this was the case, the experimenters annealed the sample, and the interlayer states would be removed around 150C. When re-exposed to atmospheric conditions, the states would return, suggesting a CO, or CO_2 contaminant. To investigate the pre-edge states, the experimenters perform DFT calculations. The pre-edge was found to not be intrinsic to graphene, but from doping of the sheet from ions due to the transfer process. By artificially ionizing the graphene sheet (in the calculation) they found that the pre-edge feature could be reproduced. To see if there was doping in the experimental case, NEXAFS of the Fe L-edge was taken. There was definitely Fe on the sheet.

Insight

This paper appeared to have a much more concrete reason for the assignment of the pre-edge and interlayer features in the NEXAFS spectra. I would agree with their findings, but I think more investigation would need to be done to verify the results. They note that according to Hua *et. al.* the pre-edge feature comes from edge atoms or missing C atoms. They do not dispute this idea, but only establish that it would be difficult to measure. This leaves the debate still open. I would say the 'interlayer' states are indeed adsorbents, simply from the results presented here. One note about the rippling of the graphene sheet that I am still unsure about is why they think the π^* peak intensity variation is only due to rippling. The intensity change could come from multi-layer graphene (MLG). The experimenters performed Raman, but they did not do topographical Raman. This

should be done to correlated whether or not the changes in π^* intensity come from rippling or from MLG.

Application to Research

This paper has many parts to it that I could use to aid my research. I would like to test using DFT to see if the pre-edge feature could come from thin nano-ribbons. I could also test if it comes from missing C atoms. As I mentioned earlier, I wanted to try STXM on the graphene sheets I am making for my study. I think topographical indication of the variation of the NEXAFS spectra would help the study. I think that the metal adatoms will affect the graphene electronic structure, NEXAFS will indicate the change in the atom-specific UDOS. I can then also verify my findings from STXM using STM/STS. STM/STS will give me total DOS (convoluted with the tip's DOS of course). The two measurements should give me a good idea of the result of adsorption of metal on the graphene surface.