Reading Literature Articles

As you progress in your professional or academic careers, you will find that one of the most useful skills is being able to critically read a technical document and distill the important concepts. In this course we will work on strategies that will help you learn how to read and evaluate a paper from the literature on surfaces and interfaces. These guidelines are based upon the two following general ideas. 1) Critical reading of a scientific paper is a matter of first asking your own questions about the material and 2) effective integration of the information in the paper into your larger body of knowledge (this is the "do you see the big picture" concept). As you read scientific articles, begin by following these steps:

1. **Read the title and abstract and introduction**
   - If the article is well organized then the take-home message will be in the abstract, and the title will set you up to expect the information in the abstract and then the paper. The introduction will inform you of the scope of the field and should convey the significance of the work presented. Think about the topic and ask yourself if you are familiar with the techniques they are using and the area they are studying.

2. **Look at the pictures and ask questions**
   - Someone who is familiar with the techniques used and the area studied should be able to get the main points of the paper just by looking at the data (graphs, tables, and other figures). A well-written paper uses graphs, charts, tables, and figures to support the claims presented. By looking at the figures first and asking your own questions you will probably ask at least a few questions that will be answered in the text of the paper. Make notes about the things that you understand from the figures and questions about what you don't understand. When you read the text look for the answers to these questions; they will probably be there.

3. **Read materials and methods (experimental section) and results**
   - It may be useful to reread the introduction and the abstract at this point to see if you better understand the focus of the paper after studying the figures. Mark every place where one of your earlier questions is answered. Be sure to also note where you don't understand the material (these questions may be answered in the discussion section). After reading this far you should have a sizable list of questions yet unanswered.

4. **Read the discussion section of the paper carefully**
   - At this point you should really know what to expect in the rest of the paper. Namely, the bulk of your questions should be answered or at least revealed and left open to further study and explanation. Note all of your remaining questions as you will include them in your report. Try to answer your questions with other sources, such as your textbook or another book in the library or my office.

5. **Analyze the paper and write your report**
   - **Prior knowledge** - Why are the authors doing what they are doing? What has happened up to this point to make this a useful contribution? What is the state of understanding that led them to do this work? Use your own words in identifying the answers to these questions.
   - **Hypothesis (purpose)** - Most scientific papers should either pose a question and then answer it, identify a new process, develop a new material, disprove or prove a hypothesis, or explain some previously unexplained phenomena. You should be able to determine what the author's have done that is new or how they have added to the existing knowledge in the field. The framing of this material should be in the paper but it may not be in a concise or explicit form. State the purpose or hypothesis of the paper in your own words.
Experimental Results - What did the author's find? Did they discover something new? Did they validate a technique? Did they disprove a proposed hypothesis? Did you find their data convincing? Were there assumptions made? If assumptions were made, were they valid? Was the result what they expected? Do you agree/understand their interpretation? Are the figures presented in a manner that supports their claims? Was the paper informative and useful overall? Think about all of these questions and summarize the findings of the paper in your own words. This should be the bulk of your report. Include aspects that you don't understand or don't agree with in the paper. State your overall impression of the paper.

Assessment - Have the author's provided some new information, added to the current understanding of a particular field, or discovered a new material or process? What made this paper worthy of publication? This is your chance to state your opinion. The paper may have been well-written and informative, but you may think, "Why bother with science of this nature", be sure to state all of your opinions about the paper.

Future work - Propose a couple of questions or experiments that could be investigated in the future. Think about what the next step might be. Most papers will leave some unanswered questions; state how you would design an experiment to answer these questions.

Write the section above in paragraph form. It must be brief – less than ¼ page total. Most of all, be specific.

Write the section below as a series of bullet points. You must either typeset the equations (using equation editor or some equivalent), or print them very neatly.

Show your understanding of the theory as it relates to 446 – This section will account for 50% of your literature report score. Consider Figure 2:

1. The title of the article is "How Wenzel and Cassie Were Wrong". However, both the Cassie and Wenzel equations correctly predict contact angle, if they are used correctly.
   a. Write the Wenzel equation, and briefly explain the restrictions on its use.
   b. Write the Cassie equation, and briefly explain the restrictions on its use.
   c. The authors measured the contact angles of drops on surfaces that contained both smooth and rough areas. Calculate the roughness factor for the rough area using advancing contact angle.

2. Assume that the surface energy for silicon (100) plasma-cleaned with oxygen is approximately 1,500 mJ/m². Calculate the interfacial energy for the water/silicon surface using data from the paper.

3. The authors made silicon hydrophobic by modifying the surface with heptadecafluoro-1,1,2,2-tetrahydrodecyl)dimethylchlorosilane. Draw the structure of the surface that results. (See chapter 10 if you need help.)

4. The surface that you just drew has some resemblance to Teflon (PTFE). The surface energy for PTFE is approximately 20 mJ/m². Calculate the interfacial energy for the water/modified silicon surface using data from the paper.