Lab Report Template

Lab 1 - Metallography

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1. Summary

This lab was conducted by analyzing four different metal samples, SAE 1020, Ingot Cast Iron, SAE 1045, 1045 and unknown which was later determined to be SAE 1080. The objective of this experiment was to be able to determine the differences in properties between samples based on microstructure, etching time, grain size and carbon content. This process was done first by mounting the samples in Bakelite using the presses. These pucks containing the samples were then grinded down until it was flat. Then it went through various sanding grits from 240-600 while rotating to ensure scratches were minimal. These samples were then polished and etched with Nital which would dull it to better examine the properties of the specimens on the microscope. The time the etching took also varied between samples as seen below, with SAE 1020 being the smallest and Ingot Cast Iron having the longest time. The photos were then taken of the samples microstructures as seen through the microscope. Using these photos, we were able to determine that the unknown structure was SAE 1080 Steel since its pearlite content was highest of the four samples.

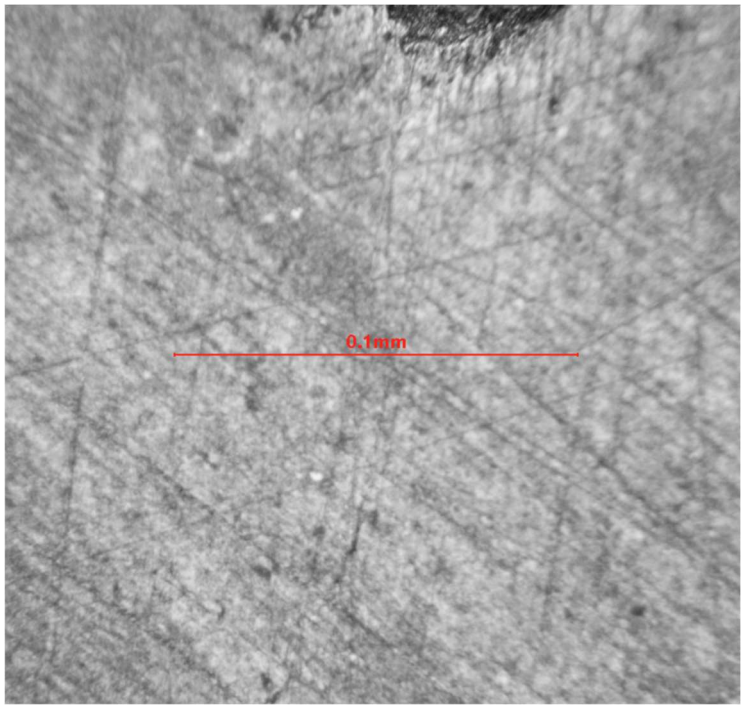
2. Results and Observations

2.1 Record the etching response time for each sample in the table provided

Sample	Etch Response Time (Seconds)
Ingot Cast Iron	29.32
SAE 1020 Steel	19.43
SAE 1045 Steel	23.95
Unknown Sample	26.60

2.2 Attach the micrographs of the four samples in the space provided. Indicate the magnification and label all phases present. Record additional observation in the space provided (e.g., differences between the microstructure of these samples).

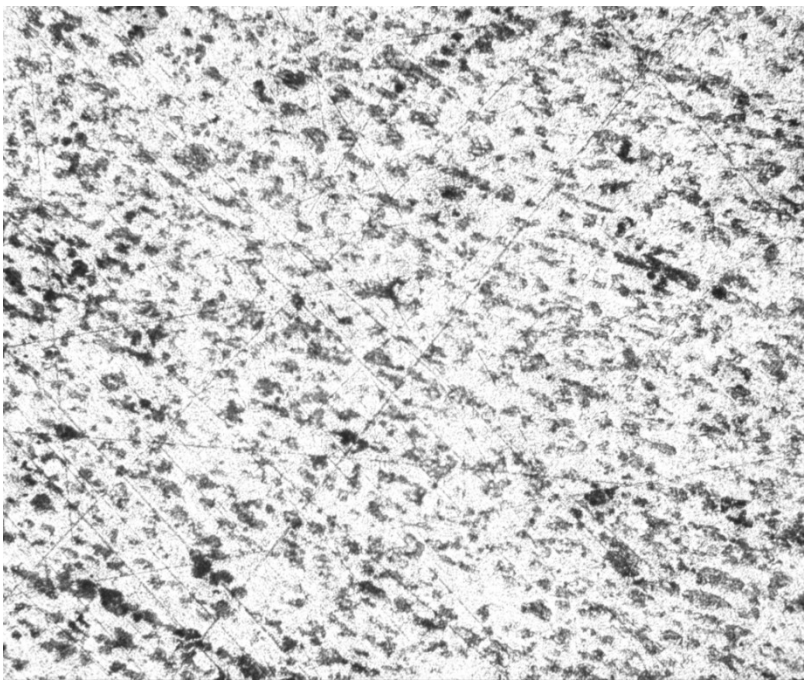
Sample #1 - Ingot Cast Iron Micrograph



Additional Observations

While this sample may not have very distinctive properties due to mishaps in the process, the lack of pearlite can still be noted which is consistent with this sample being cast iron. Cast irons while having over 2% pearlite still have minimal amounts ~10% compared against the other samples.

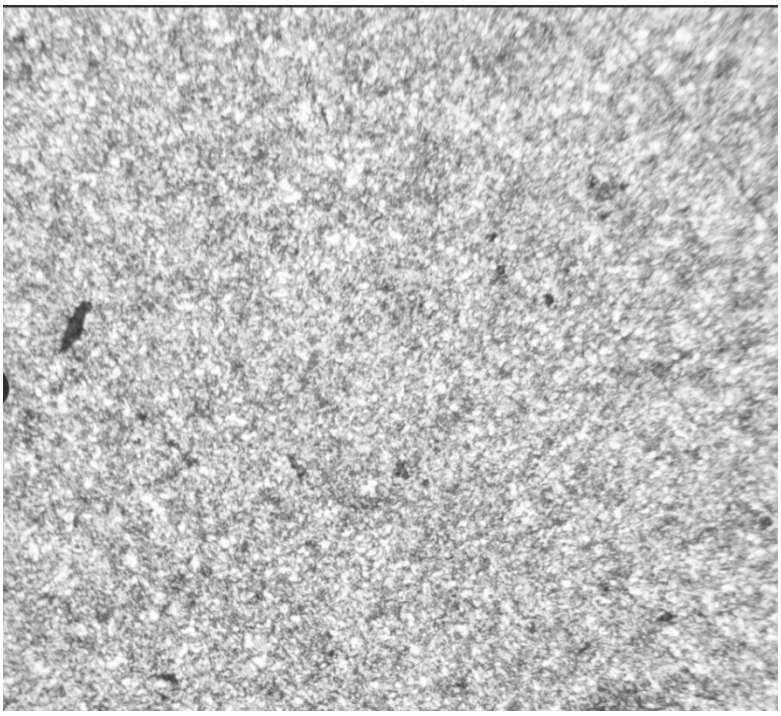
Sample #2 - SAE 1020 Steel Micrograph



Additional Observations

10x magnification, here the differences in the pearlite and ferrite can be seen very clearly. There is only 20% pearlite as noted by the name and seen by the dark grain spots. The grains relative to ferrite are small and the lines are very distinct.

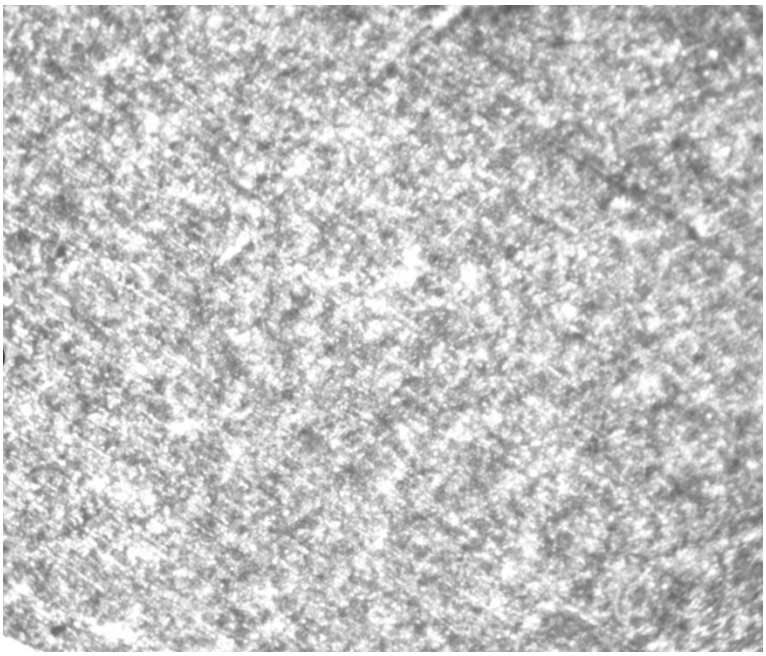
Sample #3 – SAE 1045 Steel Micrograph



Additional Observations

In this sample there is almost 50% pearlite hence the 45. This can be seen through the image, although its not the clearest image the light spots and dark spots are around evenly split. This sample has a very clear difference from 1020 since it had more sparce occurrences of pearlite.

Sample #4 - Unknown Sample Micrograph



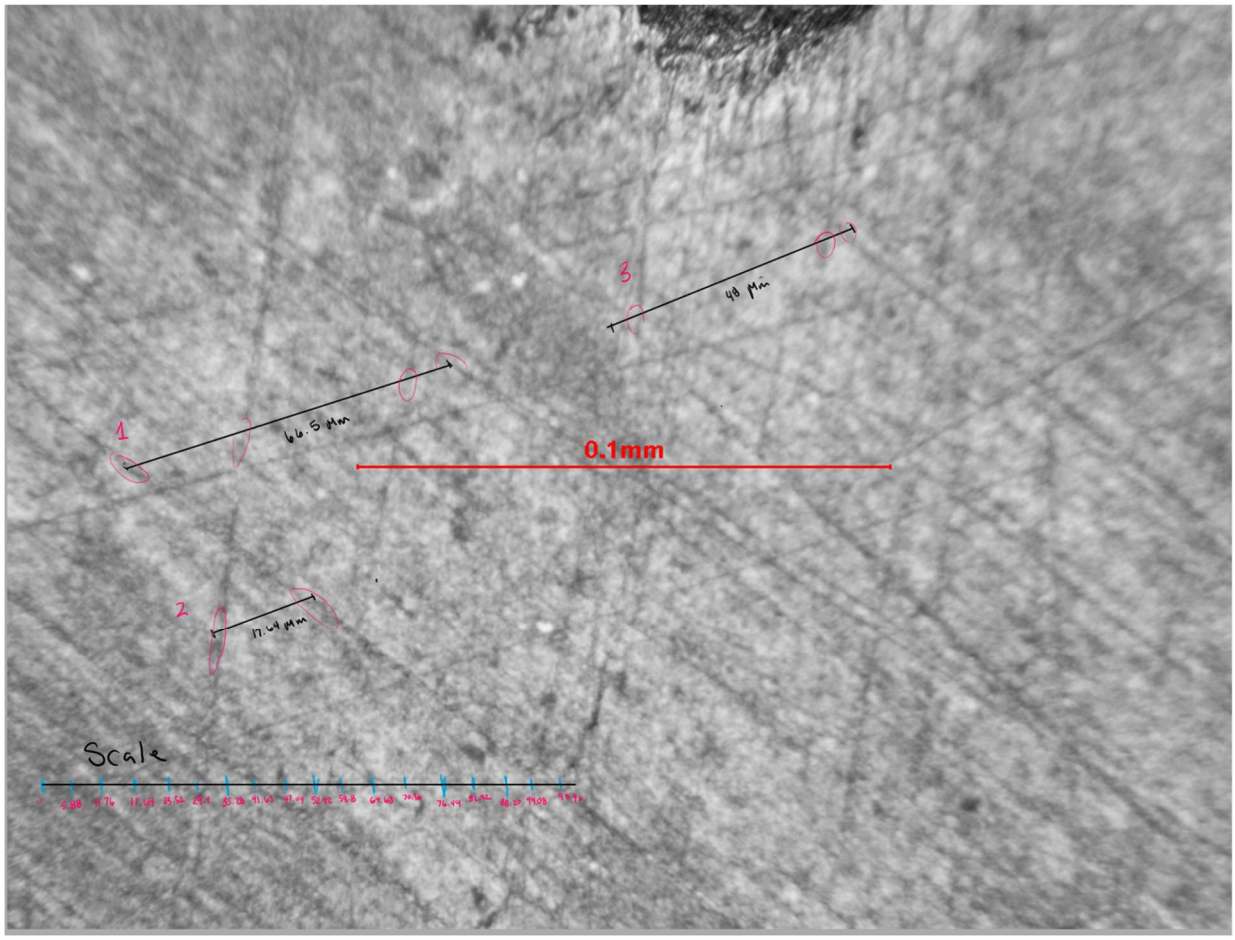
The unknown sample is:

SAE 1080

Additional Observations

As mentioned in the lab manual the steels SAE 10XX are named based on carbon content within. The increasing carbon contents creates more of “dark spots”(pearlite) and this sample had the most of this even more than 1045 which is why the sample is 1080.

2.3 Calculate the grain size (grain diameter) of Sample #1 (the ingot cast iron). Take three measurements and show your grain size calculation in the space provided.



NOTE* Due to issues with microscope, picture appear unclear, the following grain boundaries are rough visual estimates.
Measurement 1: 66.5 µm, 4 grain boundaries crossed
Measurement 2: 17.64 µm, 2 grain boundaries crossed
Measurement 3: 48 µm, 3 grain boundaries crossed
Grain Size Calculation= (Length of Line)/ (Grain Boundaries Crossed)
Measurement 1: 66.5/4= 16.63 µm
Measurement 2: 17.64/2= 8.82 µm
Measurement 3: 48/3= 16 µm

Average of Grain Size Calculations for three Measurements:
(16.63 + 8.82 +16)/3= **13.82 µm**

3. Provide answers to the questions given by the TA and attach them to the end of this template.

What is Chemical Etching? Describe the mechanism of action of an enchant like Nital and how chemical etching produces contrast for brightfield optical microscopy.

Chemical etching removes a layer of polished metal and provides contrast between structural parts. This allows for the metals properties to be examined when amplified by a microscope. Nital is used on iron and steel commonly; Nital removes parts of grain boundaries that leave a groove to be able distinguish between grains. When this is magnified it becomes a clear outline showing where the boundaries are. This bounder size and shape can be examined to determine material.

Compare the response time of the ingot Iron and the SAE 1
Hint: use the sample Etching response times.

Iron has a longer etching response time than the SAE 1 carbon than steel this longer time could be a effect of carbon increasing the strength and ductility which would result in effective etching taking longer.

you've missed explicitly mentioning one point in particular, which is the increasd grain boundary area

-0.25 marks for forgetting this.

Discuss the effect of increasing carbon content on th [Fe3C] in the microstructure of plain carbon steels

As briefly mentioned above, pearlite increases st steels, and the cementite increases the hardness bu balance out to create ideal material for a variety of e structure more layered which can be observed using grains also changes as pearlite and cementite are inc

the answer is partially incomplete. Once you get past 0.8% C, you'll actually see a two-phase microstructure with a decreased volume fraction of pearlite compared to cementide. I would have liked to see a mention of this.

-0.25 marks overall.