University of Jordan

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Properties of Materials Laboratory

Instructor:

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Introduction and Objective:

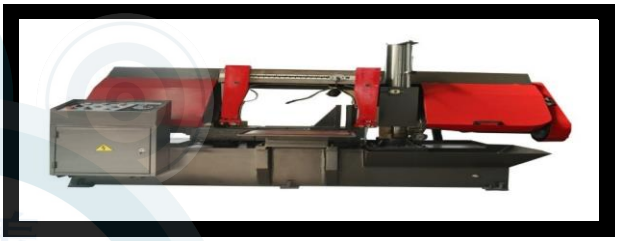
Microscopic examination, which identifies and counts the type of cells, casts, crystals, and other components such as bacteria and mucus that can be present in urine.

It is used to reveal the microstructure of the metals and alloys, such as: location, type and distribution of nonmetallic inclusions, grain size, degree of cold working, segregation, finishing temperatures, and cooling rates.

In this experiment, we used this technique to find the grain size, and we applied it on steel using a laboratory microscope to see the structure of the metal.

Materials and Equipment's:

1) Cutting Machine



2) Grinding Machine

3) Grinding paper grades of (120,180,240 and 400)

4) Comparting Mounting Machine

5) Aluminum Oxide (AL_2O_3) for polishing
6) Water and Ethanol (C_2H_5OH for cooling

7) Thermoplastic resins

8) Solution consisting of 2.5% HNO_3 and Ethanol
9) Microscope

10) Ruler and Calculator
11) Specimens of Aluminum and Steel

Experimental Procedure:

1) Select the specimen which we're concerned in this study (Al, Steel)
2) Cutting the specimen to achieve the wanted volume by using the cut-off machine, to avoid the overheating, we add water during the process.
3) Because we obtained a small specimen with irregular shape, the second thing we need to do is to mount this specimen in thermosetting plastic such as Bakelite using hot compression mounting or cold mounting.
4) It depends on the properties of the specimen to determine which technique is more convenient, in this experiment we're using the hot mounting technique. these techniques make it possible for us to see the orientation of the specimen during grinding and polishing.
5) The mechanical preparation is simply divided into two operations: grinding and polishing,

6) In order to obtain a soft smooth surface, we use grinding machine along with grinding paper with all its degrees (120,18,240 and 400) and when the grinding using the first paper is done, we rotate the specimen by 90 degrees, this helps us beneficially to remove all the deformation which the coarse scratches have been produced by a series of new finer ones, during the whole process the cooling fluid is a must.
7) After that we start polishing, which is normally done in two steps: rough and fine polishing. Low speed and heavy hand pressure are employed, which will result in cool, rapid, cutting with the sharp diamond grits and minimum of surface deformation.
8) now, we start etching the specimen to remove the disturbed and deformed of metal of finite thickness, this chemical etching effectively removes the layer by subjecting the polished surface to carefully controlled chemical attack by an appropriate reagent.
9) Finally, we put the specimen on microscope to clearly see the shape and size of the grains.

Discussion and Results:

After finishing all the steps related to the Microscopic Examination thoroughly including: sMaterial selection, mounting, grinding, polishing, Etching. We saw the specimen through the microscope and we were able to see the structure of the specimen clearly, and based on that we were able to calculate the average grain size by applying these steps:

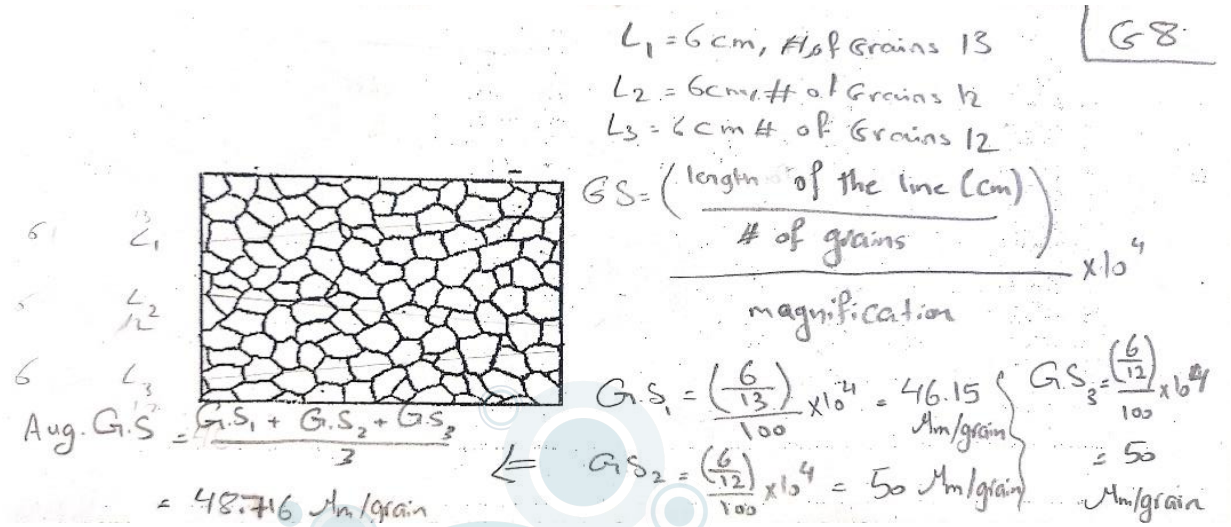
Grain size = (length of line (cm)/ number of grains x 10^4)/ magnification
Line 1 = 6 cm, number of grains 13
Line 2 = 6 cm, number of grains 12
Line 3 = 6 cm, number of grains 12

Magnification x 100

Grains Size 1 = (6/13) x 10^4 / 100 = 46.15 Mm/grain
Grain Size 2 = (6/12) x 10^4/100 = 50 Mm/grain
Grain Size 3 = (6/12) x 10^4/100 = 50 Mm/grain

Average Grain Size = (Grain Size 1 + Grain Size 2 + Grain Size 3)/3
Average Grain Size = 48.716 Mm/grain

We drew straight lines that pass through as many grains as possible without intersecting
With each other. We measured the length of the lines using a ruler. We multiplied the length of
The lines/number of grains by 10^4 to convert the unit from centimeter to micrometer.
1 cm = 10^4 micrometer



Conclusion:

This report has discussed the microscopic examination experiment.

The objectives of this lab were to examine the selected specimen in a laboratory microscope, then calculating the average grain size for each sample. Following procedures that were mentioned above (selecting, mounting, …), we were successfully able to scan the specimen's structure clearly under the microscope, then printing its picture so we can manually calculate the average grain size using its formula.

References:

Experimental Laboratory Manual in Materials Science and Engineering

YouTube videos

Notes from the experiment

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TEAM