METC 143 Lab Report

2015 Spring

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CONTENTS

Centrifugal Casting Machine

Lab 1

1. Centrifugal Casting Machine (1)

OBJECTIVE

To understand features/benefits, how it works, and what kind of products are made by process of **Centrifugal Casting Machine**.

1. Centrifugal Casting Machine (2)

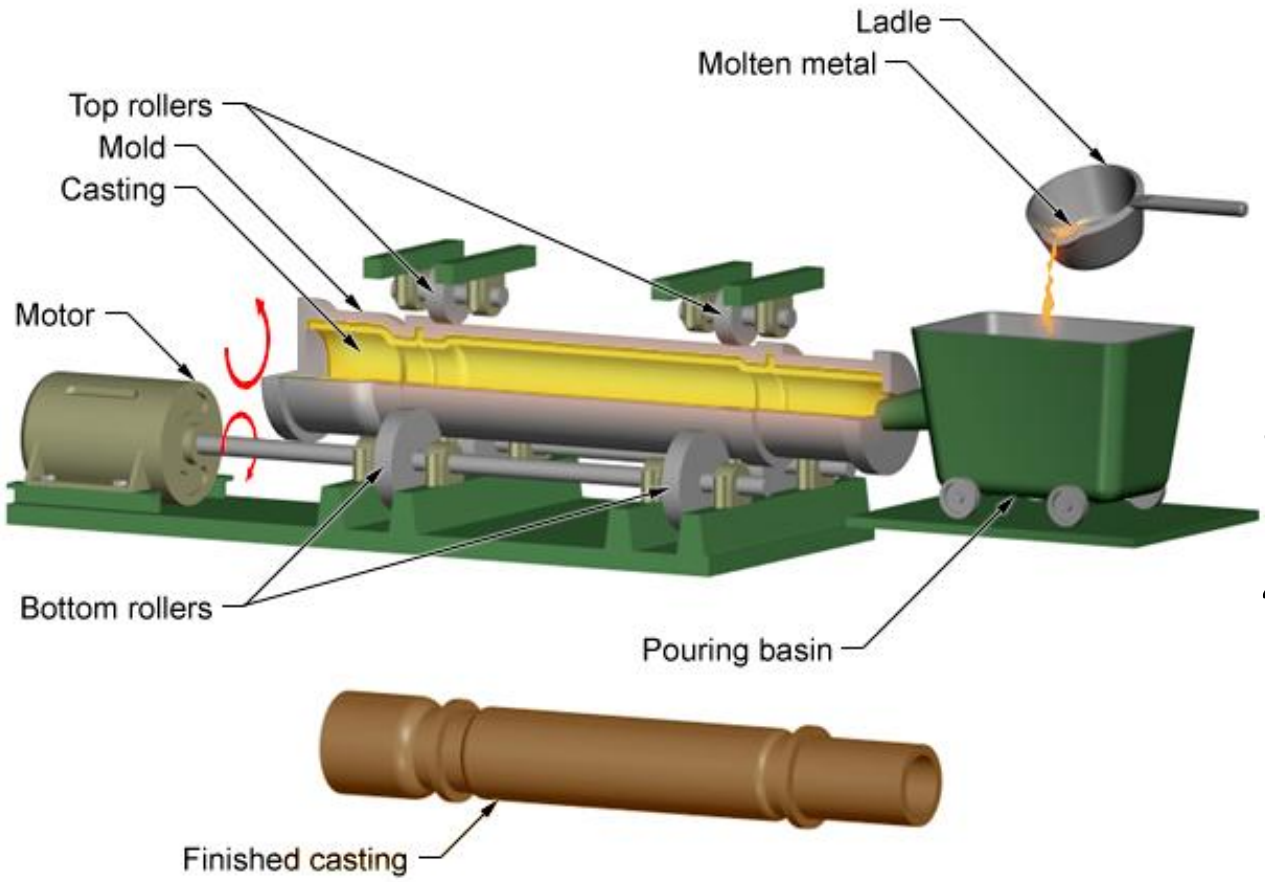
FEATURES

- 360° completely uniform
- Seamless, vacuum tight
- Leaving a defect-free structure without cavities or gas pockets
- Very high material soundness
- Nearly any ferrous or non-ferrous alloy can be produced

https://www.youtube.com/watch?v=ojagGoNTyFs

1. Centrifugal Casting Machine (2)

HOW IT WORKS?



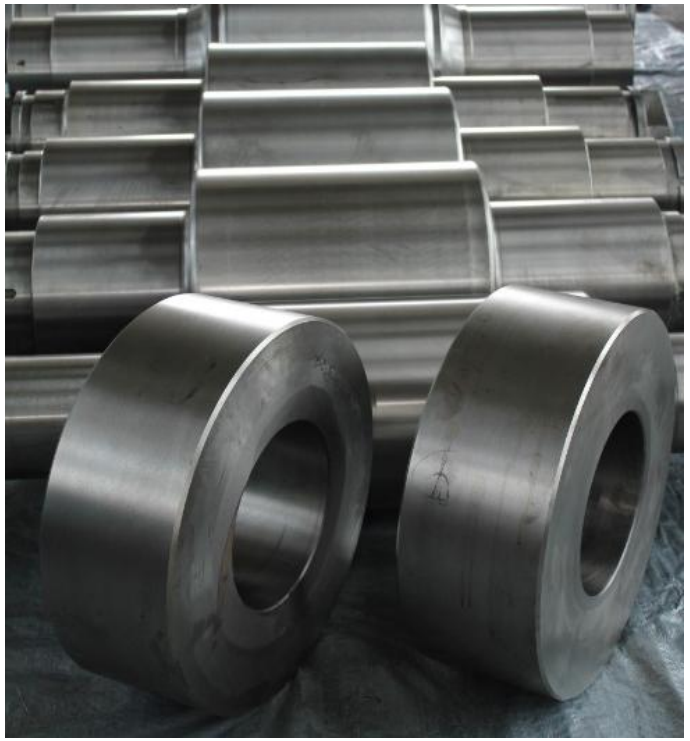
1. Molten metal is poured into a basin.
2. From the basin, molten metal is transported to the rotating mold along the pipe, and it is forced against the mold wall under a high pressure.
3. The molten metal is cooled down by the mold evenly and it will be solidified.
4. The final product is ejected and cool down to the room temperature.

https://www.youtube.com/watch?v=ojagGoNTyFs

1. Centrifugal Casting Machine (3)

PRODUCTS MADE BY CENTRIFUGAL CASTING MACHINE

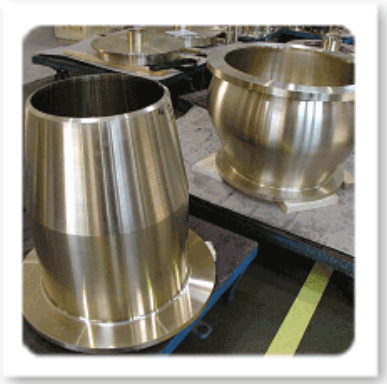
Those are the products made by centrifugal casting machine.
Any kind of tubular/cylindrical forms you can make using centrifugal casting machine.



Cylinder

Satellite

Railway Wheels



Steam Turbine Parts

Cymbals

CONTINUE…

1. Centrifugal Casting Machine (4)

PRODUCTS MADE BY CENTRIFUGAL CASTING MACHINE

Not only small products, centrifugal casting machine can produce massive stuff such as Underground Pipes or Radiant Tubes.

Radiant Tubes

Underground Pipe

1. Centrifugal Casting Machine (5)

CONCLUSION

- 360° completely uniform
- Seamless, vacuum tight
- Leaving a defect-free structure without cavities or gas pockets
- Very high material soundness
- Nearly any ferrous or non-ferrous alloy can be produced

Material Saving, Energy Saving, and High Efficiency

Hardness Test: Mitsutoyo HR-500

Lab 2

2. Hardness Test: Mitsutoyo HR-500 (1)

OBJECTIVE

To understand what is **hardness** and how to use hardness testing machines, Mitsutoyo HR-500.
To find which is the harder material between Aluminum and Copper by comparison.

2. Hardness Test: Mitsutoyo HR-500 (2)

WHAT IS HARDNESS?

One of the property of a metal that exhibit

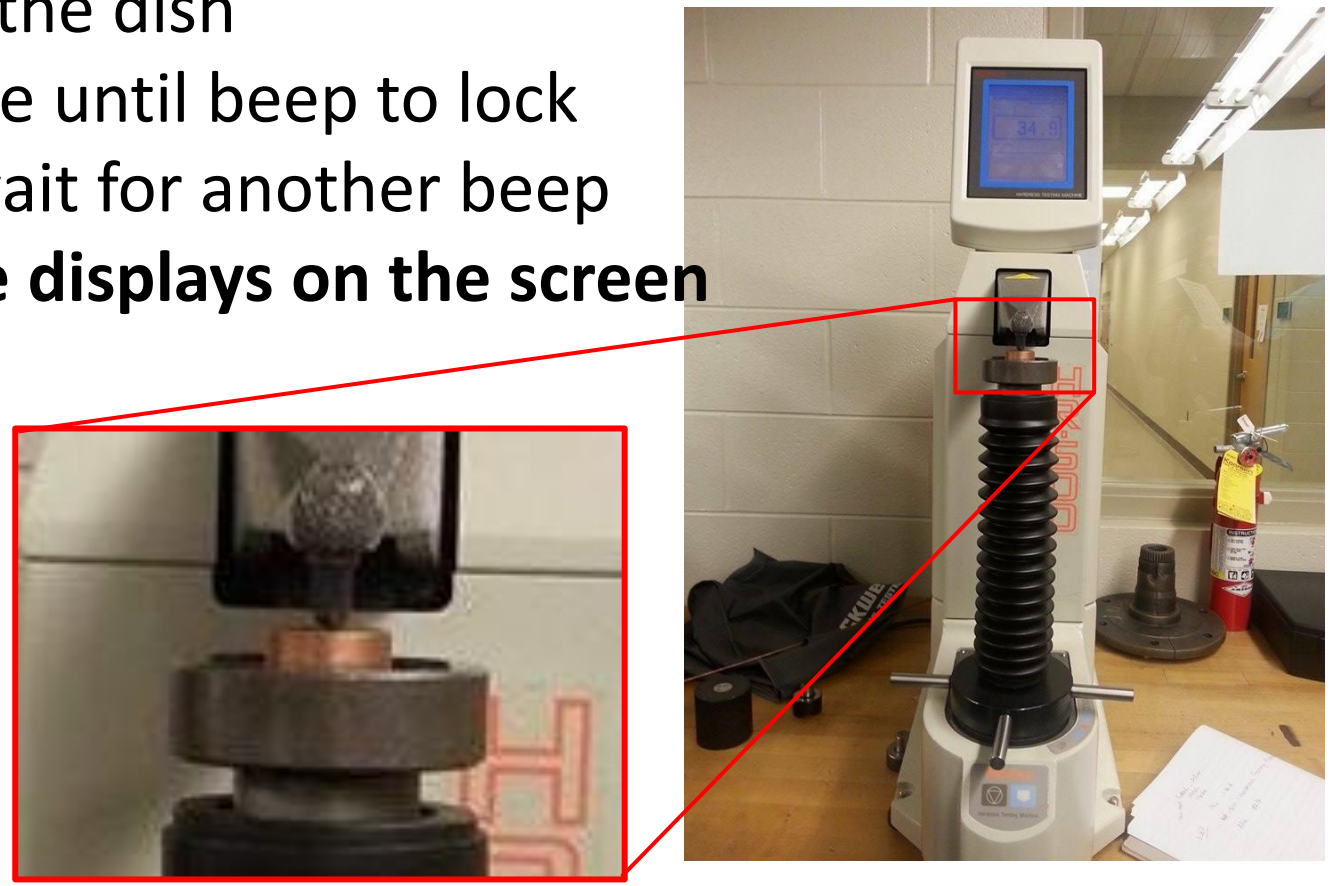
- Ability to **resist to plastic deformation**, such as bend, broken, or have its shape changed when a load is applied.
- Ability to **resist to a substance to being scratched** by another substance.
- Ability to **resist to a material to indentation**.

http://www.calce.umd.edu/TSFA/Hardness_ad_.htm

2. Hardness Test: Mitsutoyo HR-500 (3)

How to use Mitsutoyo Hardness Testing Machine HR-500

1. Set a specimen on the top of the dish
2. Turn the lever to the clockwise until beep to lock
3. The measurement starts so wait for another beep
4. **The final measurement value displays on the screen**



2. Hardness Test: Mitsutoyo HR-500 (4)

RESULT

The larger the number, the harder the material.

Material	Value	
Aluminum	42.5	harder
Copper	34.9	softer

2. Hardness Test: Mitsutoyo HR-500 (5)

CONCLUSION

I understand what is hardness and how to use hardness testing machine, Mitsutoyo HR-500.
For the result vaue, the larger the number, the harder the material.
Thus, we observed Aluminum was harder than Copper.

Hardness Test: Rockwell Hardness Testing Machine

Lab 3

3. Hardness Test: Rockwell Hardness Testing Machine (1)

OBJECTIVE

To understand what is **hardness** and how to use Rockwell Hardness Testing Machine.

To find which is the harder material between 4140 steel and 1018 steel by comparison.

3. Hardness Test: Rockwell Hardness Testing Machine (2)

WHAT IS HARDNESS?

One of the property of a metal that exhibit

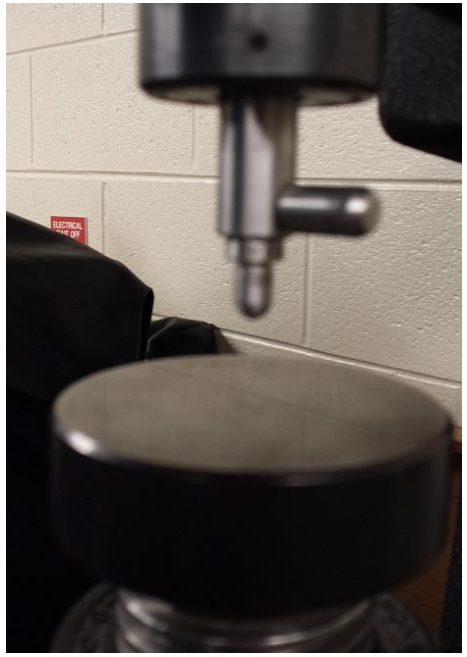
- Ability to **resist to plastic deformation**, such as bend, broken, or have its shape changed when a load is applied.
- Ability to **resist to a substance to being scratched** by another substance.
- Ability to **resist to a material to indentation**.

http://www.calce.umd.edu/TSFA/Hardness_ad_.htm

3. Hardness Test: Rockwell Hardness Testing Machine (3)

How to use Rockwell Hardness Testing Machine

1. Set a drill tip (A, B, C, D, F, G, E)
2. Change the load depending on the tip type
3. Set a specimen on the top of the dish
4. Pull the lever on the right side of the machine to lock the brake
5. Turn the bottom lever of the dish until both of the large/small needles specifies zero (vertical direction)



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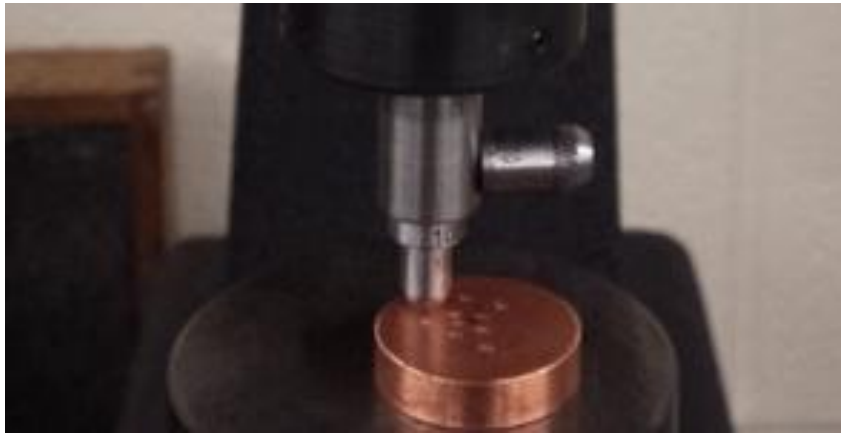
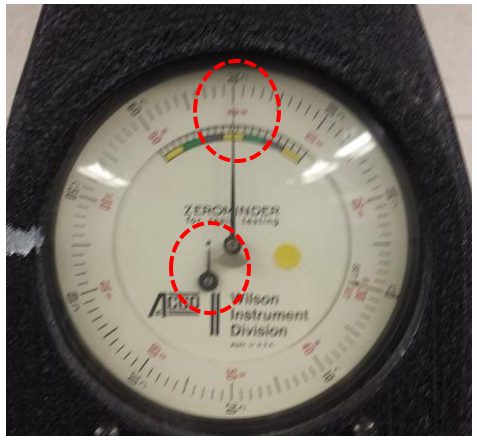


(3)



(5)

3. Hardness Test: Rockwell Hardness Testing Machine (4)

How to use Rockwell Hardness Testing Machine

6. Let the brake lever go
7. Pull the brake lever when the needle stops
8. **The final measurement value displays on the scale**
9. Let the brake lever go and while the lever moving backwards, turn the dish lever and remove a specimen
10. Pull the brake lever for the next test

(10) Final Reading

3. Hardness Test: Rockwell Hardness Testing Machine (5)

RESULT

The larger the number, the harder the material.

	4140 Steel	1018 Steel
1st try	57	36
2nd try	58	37
3rd try	65	36

3. Hardness Test: Rockwell Hardness Testing Machine (6)

CONCLUSION

I understand what is hardness and how to use Rockwell Hardness Testing Machine.
For the result value, the larger the number, the harder the material.
Thus, we observed 4140 steel was harder than 1018 steel.

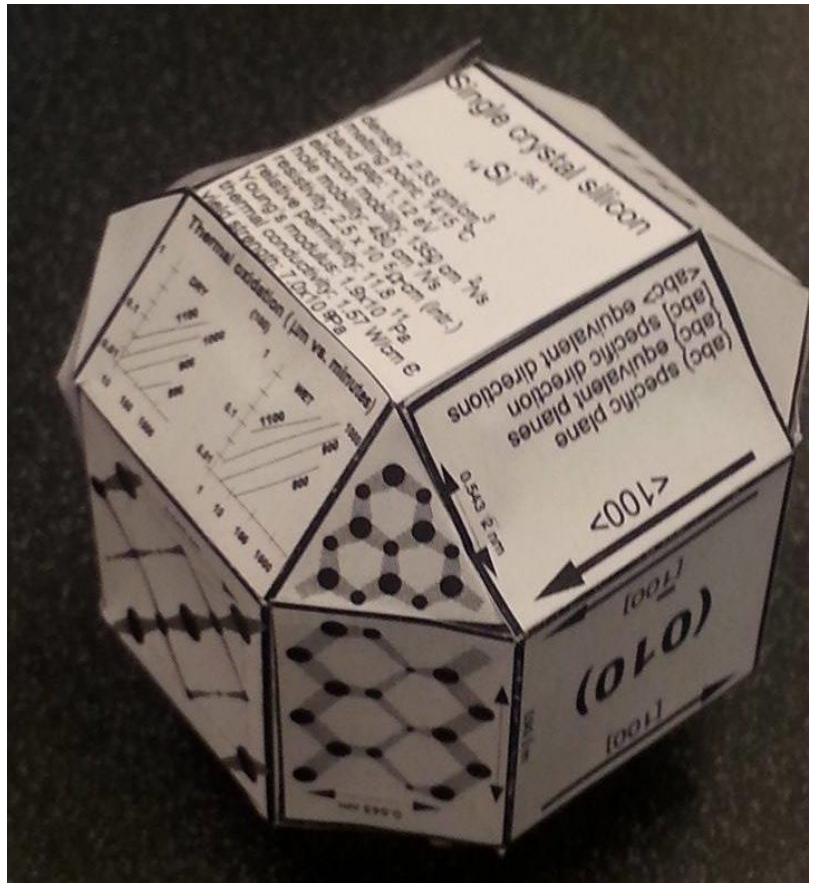
Crystal Origami Structure

Lab 4

4. Crystal Origami Structure (1)

OBJECTIVE

To understand the different crystal orientations by constructing a paper model and which helps one to visualize crystal structures.



4. Crystal Origami Structure (2)

WHAT IS CRYSTAL STRUCTURE?

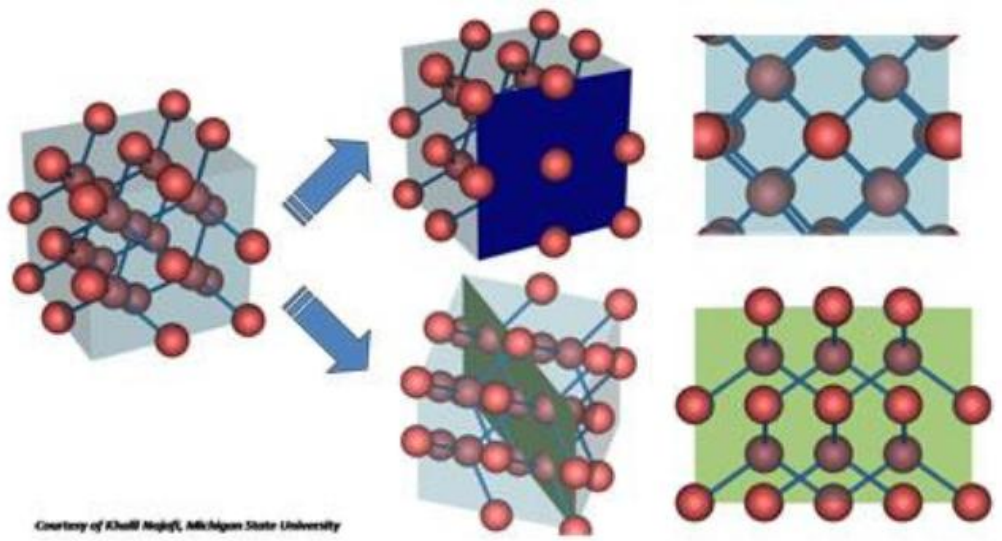
Crystals are defined by a regular, well-ordered atomic lattice structure.
A lattice consists of stacked planes of atoms.
The bonds between the atoms are typically very strong.

http://web.eng.fiu.edu/npala/EEE4996/Read_assgn_7_Crystallography_LM_PG.pdf

4. Crystal Origami Structure (3)

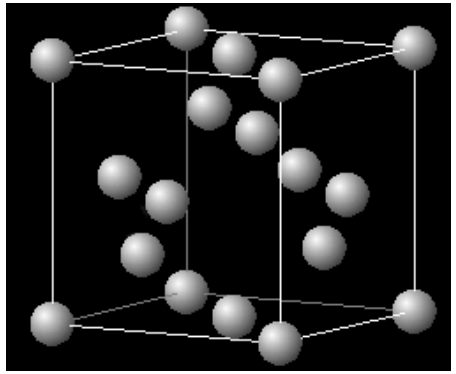
MILLER INDICES

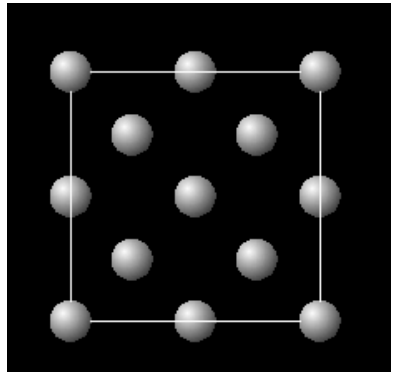
The image of crystal are different by the plane which is defined by the angle of view.



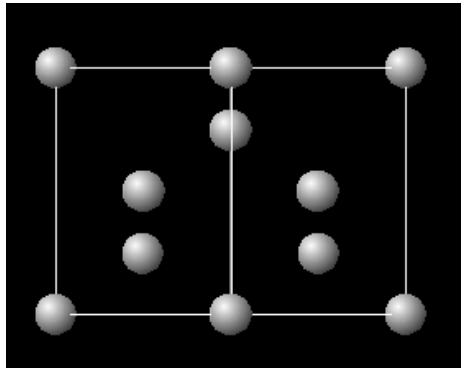
Silicon Crystal Planes

Unit cell:

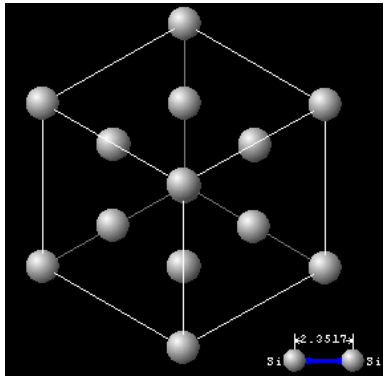




View in <100> direction



View in <110> direction



View in <111> direction

4. Crystal Origami Structure (4)

CONCLUSION

A silicon crystal consists of different planes.
Each plane has a unique set of characteristics that can affect microsystems fabrication, electrical and mechanical function.
Miller Indices identify the various planes and directions within a crystalline solid.
The construction of a paper model helps one to visualize the different crystal orientations.

Tensile Strength Test

Lab 5

5. Tensile Strength Test (1)

OBJECTIVE

To understand what is **strength** and how to use W.C. Dillon & Co Inc.'s LW model.
To draw a stress strain curve of the test material using data that are derived from tensile strength testing machine.

5. Tensile Strength Test (2)

WHAT IS STRENGTH?

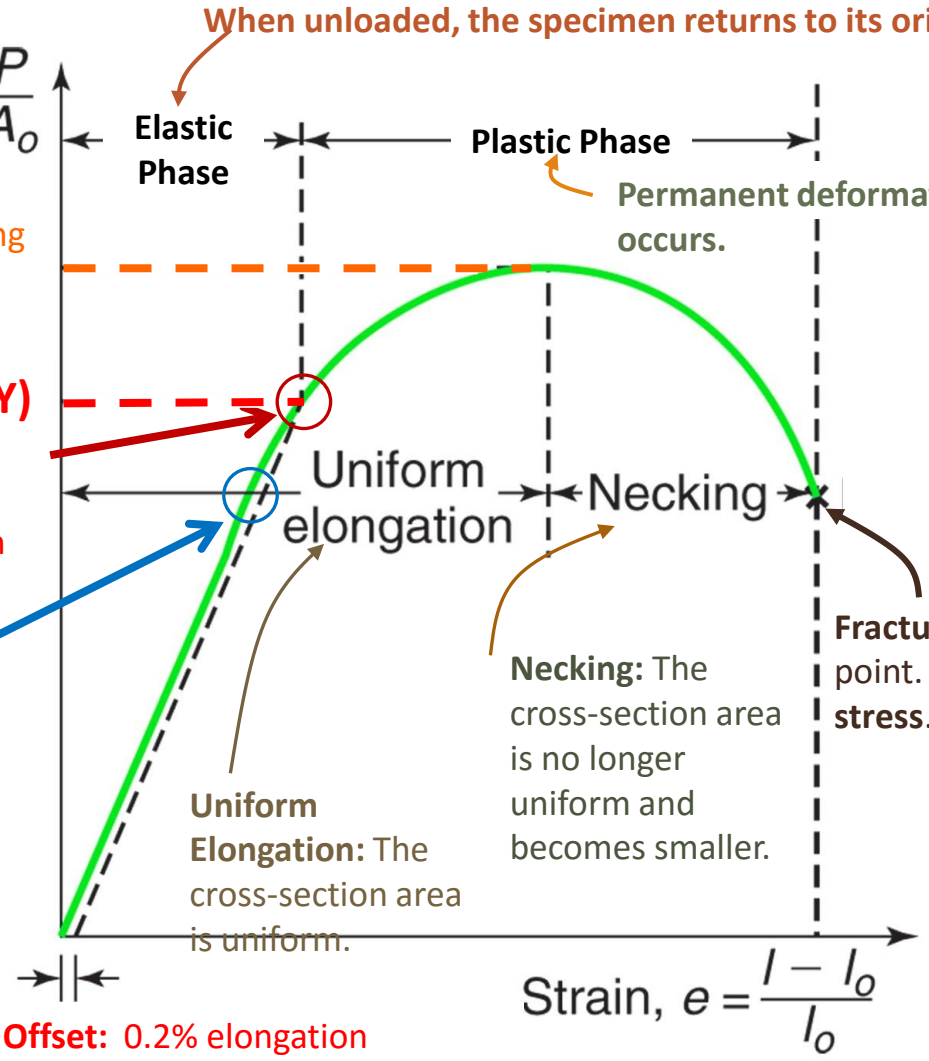
One of the property of a metal that exhibit

- Ability to **resist to plastic deformation**, such as bend, broken, or have its shape changed when a load is applied.

http://www.calce.umd.edu/TSFA/Hardness_ad_.htm

5. Tensile Strength Test (2)

WHAT IS STRESS STRAIN CURVE?



UTS (ultimate tensile strength): Maximum engineering stress point. After this point, the engineering stress begins to decrease.

Elastic Limit(耐力): Intersection of stress-strain curve and the offset curve that has same slope as the linear elastic curve. After this point, permanent deformation occurs.

Proportional Limit: At this point, the stress and strain are no longer proportional.
When unloaded, the specimen returns to its original shape.

5. Tensile Strength Test (3)

How to use W.C. Dillon & Co Inc.'s LW model

1. Screw shock absorber connector screw through shock absorber block and place bearing over top of screw so that it rests on top of block. Then insert this assembly through center hole under top casting and screw the connector screw into the Dynamometer until it is finger tight – further.
2. Attach cord to screw on side of shock absorber block. Wind cord once around block clockwise and then suspend it over pulley.
3. Screw shock absorber weight to eye bold on loose end of cord. Allow weight to hang freely. Function weight and cord is to keep shock absorber block snugly against the upper head when load is applied to the Dynamometer. When specimen breaks, the resultant shock is thereby shunted through the absorber into the heavy mass of the head. This action protects the Dynamometer against possible injury.

http://ltt.arizona.edu/sites/default/files/Dillon%20Tester%20manual.pdf

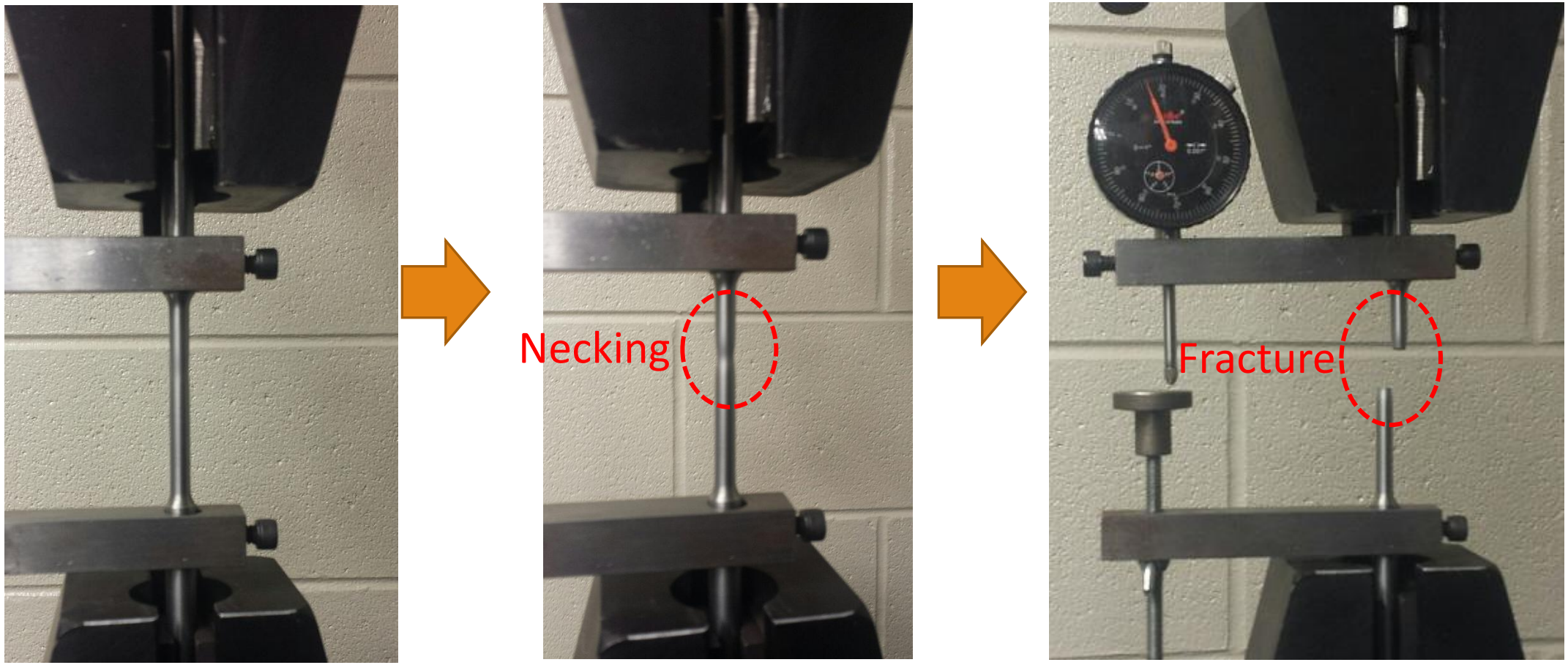
5. Tensile Strength Test (4)

How to use W.C. Dillon & Co Inc.’s LW model

4. Turn desired griping fixture onto power screw. Then mount upper gripping fixture on shock absorber screw.
5. Insert specimen to depth of at least 1” inside of gripping wedges in Type CA grips. Be sure that strap is DOWN against pins on upper grip and UP against pins on lower grip. Tighten strap screws securely. Then proceed to apply load. The main pointer will push the maximum indicator ahead of it. When specimen ruptures, the maximum indicator will indicate the peak force. The main pointer may return partially toward zero.
6. To reset for the next test, insert release bar in one of holes in shock absorber block. Turn release bar counter-clockwise. This will release shock absorber block. Turn release bar counter-clockwise. This will release shock absorber and allow main pointer to return to zero.

5. Tensile Strength Test (5)

How to use W.C. Dillon & Co Inc.’s LW model

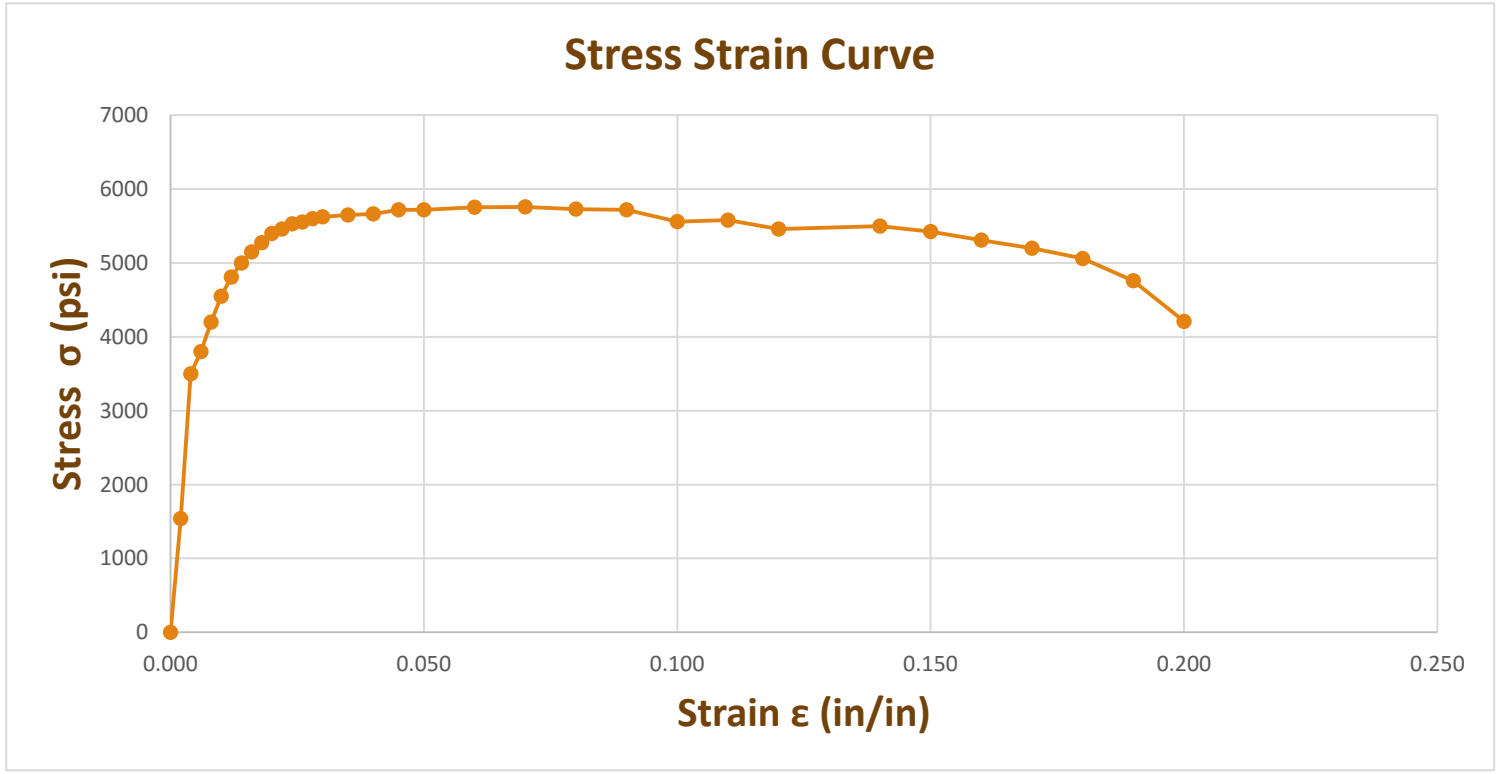


5. Tensile Strength Test (6)

Plotted Result

Original Length	**2.000**	inch
Final Length	**2.625**	inch
Max. Elongation	**0.313**	in/in

$$Elongation = \frac{(l_{final} - l_{original})}{l_{original}} [in/in]$$



Strain (in/in)	Stress σ (psi)
0.000	1540.000
0.002	3500.000
0.004	3800.000
0.006	4200.000
0.008	4550.000
0.010	4810.000
0.012	5000.000
0.014	5150.000
0.016	5275.000
0.018	5400.000
0.020	5960.000
0.022	5530.000
0.024	5555.000
0.026	5600.000
0.280	5625.000
0.300	5650.000
0.350	5665.000
0.040	5720.000
0.450	5720.000
0.050	5755.000
0.060	5760.000
0.070	5730.000
0.080	5720.000
0.090	5560.000
0.100	5580.000
0.110	5960.000
0.120	5500.000
0.130	5210.000
0.140	5425.000
0.150	5310.000
0.160	5200.000
0.170	5060.000
0.180	4760.000
0.190	4210.000

5. Tensile Strength Test (7)

CONCLUSION

We learned what is **strength** and how to use W.C. Dillon & Co Inc.'s LW model tensile strength machine.
We drew a stress strain curve of the test material using data that is derived from this machine.
Stress strain curve showed the relationship between the stress and strain for this specific material.