1. **A picture containing text, linedrawing

   Description automatically generatedThe figure shows two different room temperature true stress-strain curves for the same metal but having undergone different processing operations. For each of the following processing steps, indicate if it could produce a behavior change from 1) to 2) and explain why or why not.**
   1. **Heating near the melting temperature in an inert gas environment for 200 hours**Yes! Heating near the melting temperature may result in the material undergoing recrystallization and grain growth which could result in the increase in the ductility and toughness and decrease in the strength.
   2. **Cold rolling to 30% reduction in thickness**

No! Cold rolling a metal result in the grain structure in the metal to change from equiaxed or randomly oriented to and elongated, anisotropic structure. The elongated grains are aligned in the rolling direction. In addition, cold rolling can cause and increase in the dislocation in the material. An increase in dislocation leads to an increase in strength and hardness but a decrease in the ductility and toughness in the material.

* 1. **Heating at the recrystallization temperature for 1 hour**

Yes! Recrystallization of a metal result is the formation of equiaxed grains in the metal. This could lead to an increase in the ductility and toughness and decrease in the strength of the material.

* 1. **Conduction the tensile test at 1000x faster cross-head displacement**

No! Increasing the cross-head displacement by such a large factor would cause the material to deform more quickly than it would under normal conditions. The material may not reach its true breaking point.

1. **A tensile machine is used to stretch two specimens of identical material. For specimen 1, the initial gauge length is 3 in., and the final gauge is 3.75 in. For specimen 2, the initial gauge length is 1.75 in., and the final gauge length is 2.25 in. After the test, both specimens are annealed in a furnace at the same temperature for the same amount of time. Which specimen will have larger grains? Which specimen will be stronger?**

Specimen #1

Initial gauge length = 3in.

Final gauge length = 3.75 in.

Specimen #2

Initial gauge length = 1.75 in.

Final gauge length = 2.25 in.

Specimen #2 is expected to have larger grains as the higher strain value indicates a higher amount of prior cold work. Specimen #1 is expected to be stronger since the lower strain indicates a slower rate of recrystallization compared with specimen #2.

1. **In a Brinell hardness test, a 1500-kgf load is pressed into a mild carbon steel specimen using a 10 mm ball. The average diameter of the impression is 3.2 mm.**
   1. **Determine BHN of the steel.**
   2. **Estimate the steel’s yield strength in MPa.**
2. Given the following stress and length data for a specimen at two points during a tensile test, determine the strain-hardening exponent of the material. The specimen gauge section was initially 50 mm long.

|  |  |  |
| --- | --- | --- |
|  | l(mm) | σ(MPa) |
| Point 1 | 55.08 | 350 |
| Point 2 | 70.90 | 809 |

1. An iron grade with 2.5% carbon is held at. Referring to the figure determine:
   1. Diagram

      Description automatically generatedWhat is the chemical composition of the solid?
   2. What is the chemical composition of the liquid?
   3. What fraction of the iron is solid?