



UNIT IV FERROUS AND NON FERROUS METALS

EFFECT OF ALLOYING ELEMENTS ON STEEL

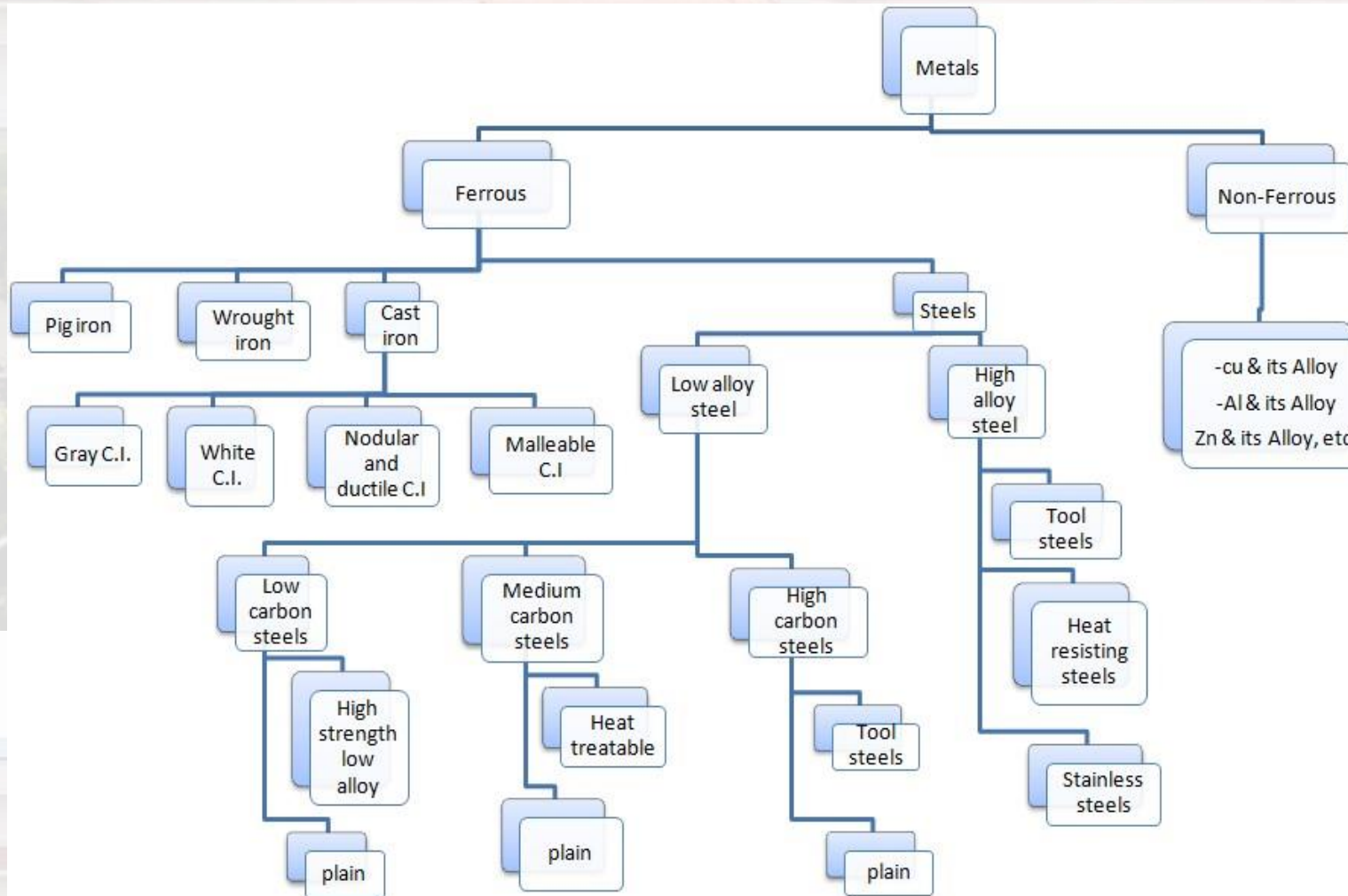
Engineering Materials and Metallurgy

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Classification of Materials





Advantage of Alloy Steel



Advantages:

- Greater hardenability.
- Less distortion and cracking
- Greater stress relief at given hardness
- Less grain growth
- Higher elastic ration and endurance strength
- Greater high temperature strength
- Battered machinability at high hardness
- Greater ductility at high strength.



Disadvantage of Alloy Steel



Disadvantages:

- Cost
- Special handling
- Tendency toward austenite retention
- Temper brittleness in certain grades.



Purpose of Alloying



- Strengthening of the ferrite.
- Improved corrosion resistance.
- Better hardenability
- Grain size control
- Greater strength
- Improved machine ability
- Improved high or low temperature stability
- Improved ductility
- Improved toughness
- Better wear resistance.



Effect of Alloying Elements

Carbon:

- Carbon content in steel affects
- Hardness
- Tensile strength
- Machine ability
- Melting point

Nickel:

- Increases toughness and resistance to impact
- Lessens distortion in quenching
- Lowers the critical temperature of steel and widens the range of successful heat treatment
- Strengthens steels.
- Renders high – chromium iron alloy austenitic.
- Does not unite with carbon.





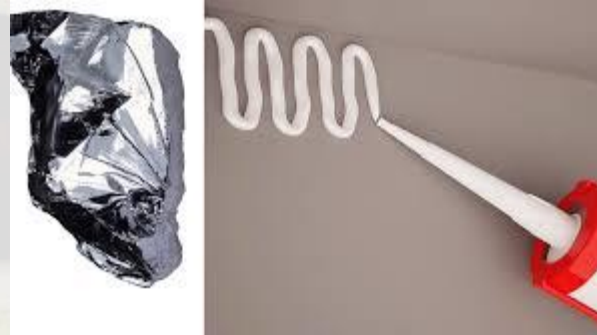
Effect of Alloying Elements

- **Chromium:**

- Joint with carbon to form chromium carbide, thus adds to depth harden ability with improved resistance to abrasion and wear.

- **Silicon:**

- Improves oxidation resistance
- Strengthens low alloy steels
- Acts as a deoxidizes.



- **Titanium:**

- Prevents localized depletion of chromium in stainless steels during long heating.
- Prevent formation of austenite in high chromium steels.
- Reduces martensitic hardness and harden ability in medium chromium steels.





Effect of Alloying Elements

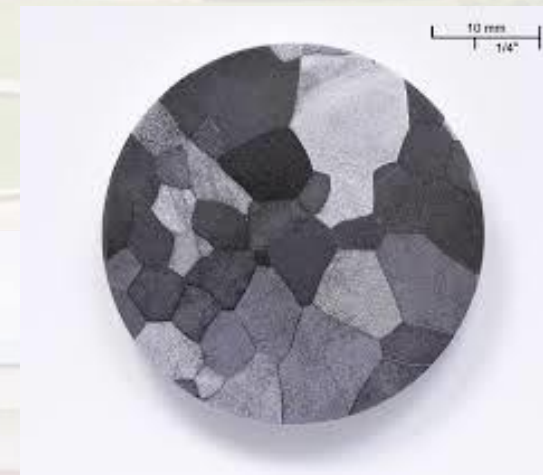
Molybdenum:

- Promotes harden ability of steels
- Makes steel fine grained.
- Makes steel unusually tough at variousness level
- Counteracts tendency towards temper brittleness
- Raises tensile and creep strength at high temperatures.
- Enhances corrosion resistance in stainless steel
- Forms abrasion resisting particles



Vanadium:

- Promotes fine grains in steel
- Increases hardenability
- Imparts strength and toughness to heat-treated steel
- It is a powerful carbide former
- Stabilizes cementite and improves the structure of the chill.





Effect of Alloying Elements

- **Tungsten:**

- Increases hardness (and also red hardness)
- Promotes fine grain
- Resists heat
- Promotes strength at elevated temperature.



- **Manganese:**

- Contributes markedly to strength and hardness
- Counteracts brittleness from sulphur.
- Lowers both ductility and weldability if it is presents in high percentage with high carbon content in steel.

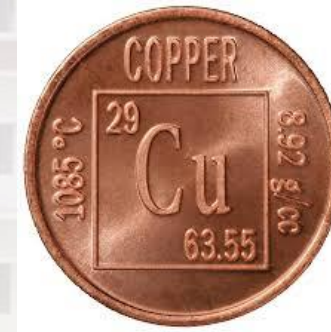




Effect of Alloying Elements

- **Copper:**

- Increases resistance to atmospheric corrosion
- Acts as a strengthening agent.



- **Boron:**

- Increases hardenability or depth to which steel will harden when quenched.



- **Aluminum:**

- Acts as a de-oxidizer
- Produced fine austenitic grain size
- If present in an amount of about 1% it helps promoting nitriding.





Effect of Alloying Elements



- **Cobalt:**

- Contributes to red-hardness by hardening Ferrite.
- Improves mechanical properties such as tensile strength, fatigue strength and hardness.
- Refines the graphite and pearlite.
- Is a mild stabilizer of carbides.
- Improves heat resistance.
- Retard the transformation of austenite and thus increase hardenability and freedom from cracking and distortion.





THANK YOU

Assessment

<https://play.kahoot.it/v2/?quizId=3360b01a-c475-40db-b720-d4463dfa61f2>