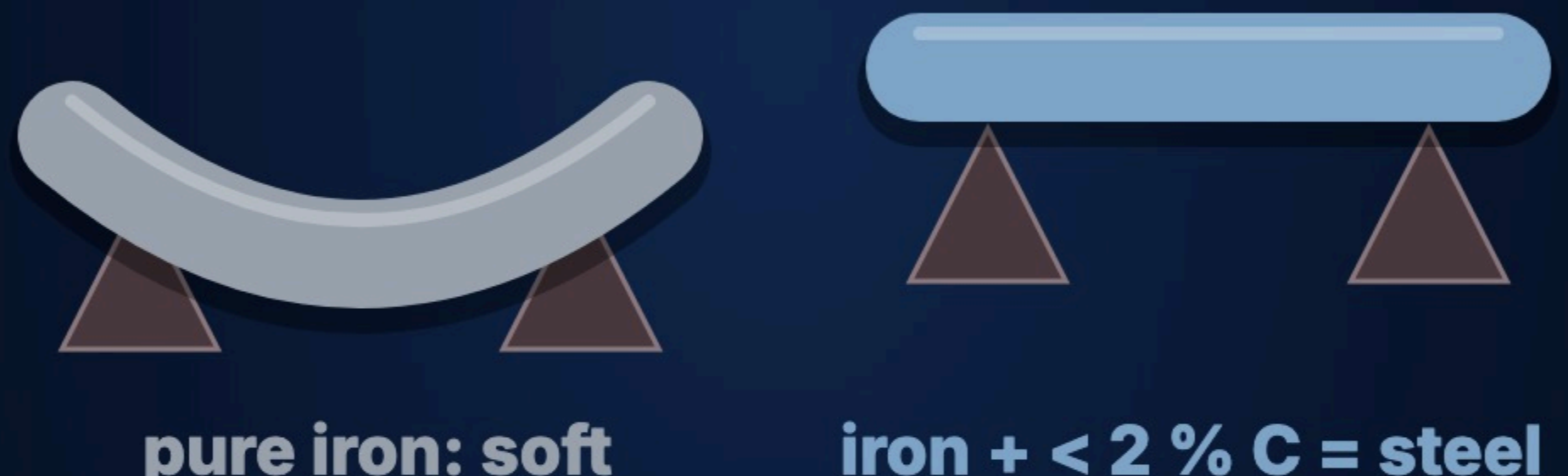
Iron bends, steel holds

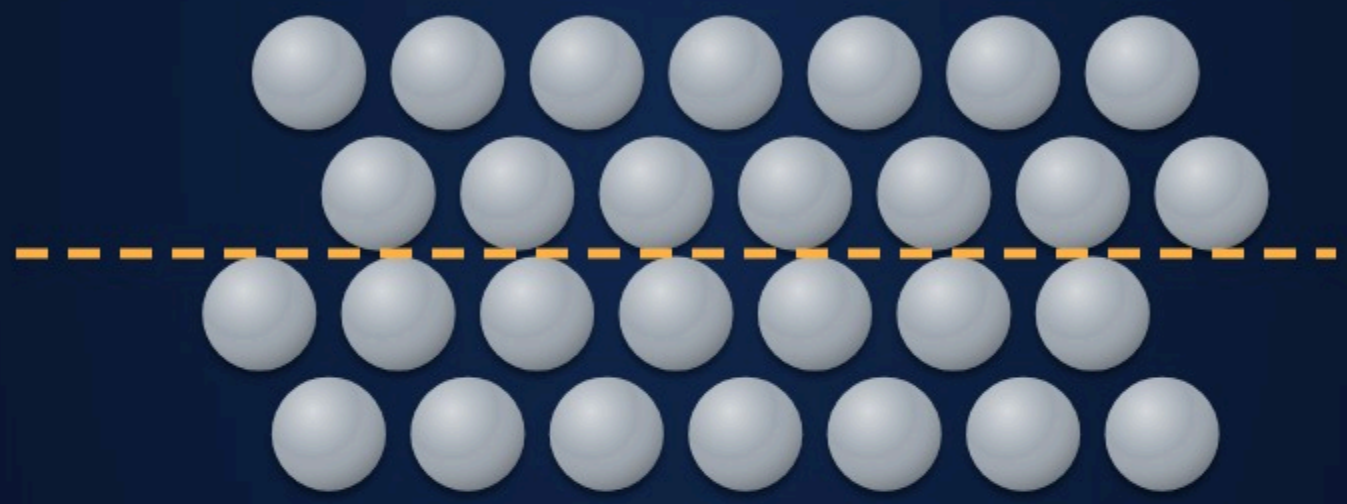


pure iron: soft iron + < 2 % C = steel

Pure iron is fairly **soft**: it bends.

Add **less than 2 % carbon** and it becomes **steel**: hard enough for bridges and rails.

Why a pure metal bends

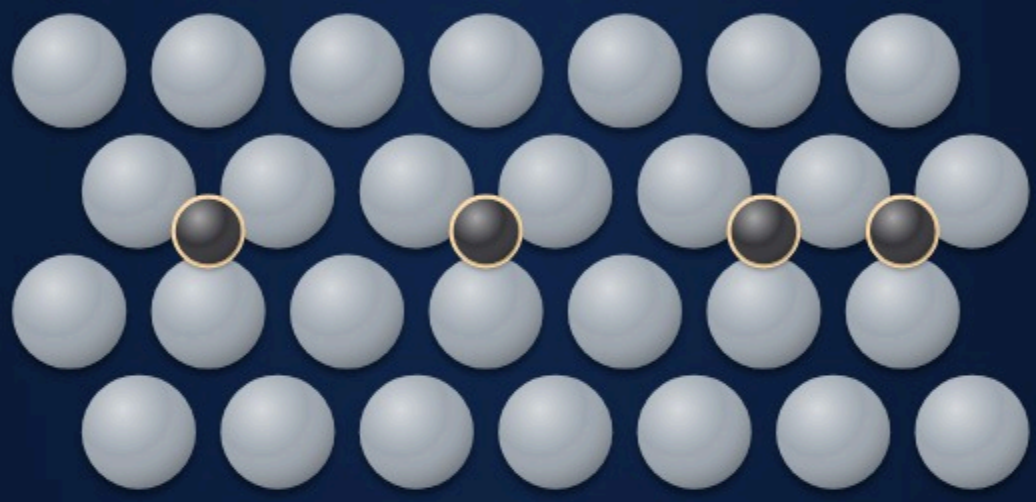


layers slide along a slip line (model)

Atoms in a metal sit in **layers**.

Push, and the layers **slide over each other**: the metal bends.

Small atoms lock the layers

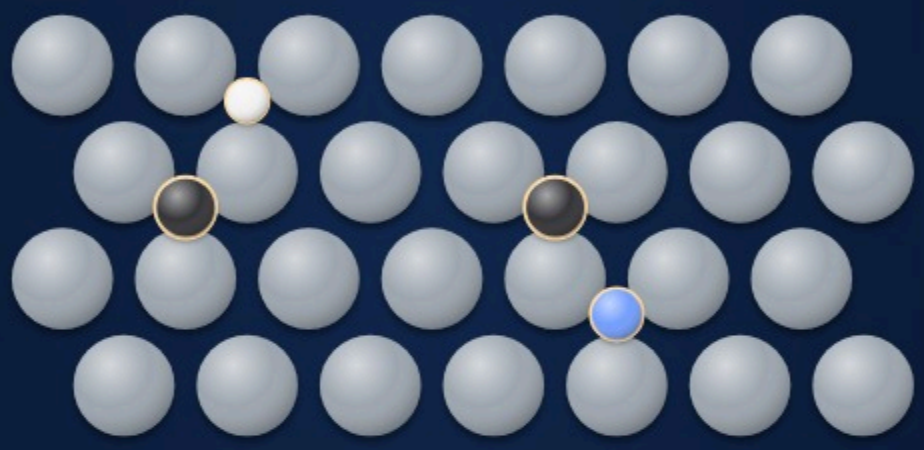


the layers can't slide → harder

Small atoms (H, C, N) fit into the **gaps** between metal atoms.

They block the sliding layers: the metal becomes **hard**.

Interstitial compounds



TiC · Mn_4N · Fe_3H · $VH0.56$ · $TiH1.7$

non-stoichiometric: no normal oxidation state

Formed when small atoms like **H, C or N** are trapped in the crystal lattice of a metal.

Usually **non-stoichiometric**, neither typically ionic nor covalent.

Their properties

- **higher melting point** than the pure metal
- **very hard** some borides ≈ diamond
- **conduct electricity** still metallic
- **chemically inert** hardly react

Example: Ti melts at ≈ 1668 °C, TiC at ≈ 3160 °C.

Hard, high-melting, conducting, inert.

Alloys: atoms of the same size



metallic radii within about 15 % → alloy

An alloy is a **blend of metals**: atoms of one are distributed **randomly** among the other.

Transition metals have **similar radii**, so they form alloys readily.

Alloys you know



stainless steel Fe + Cr + Ni



brass Cu + Zn



bronze Cu + Sn

hard, often high melting points

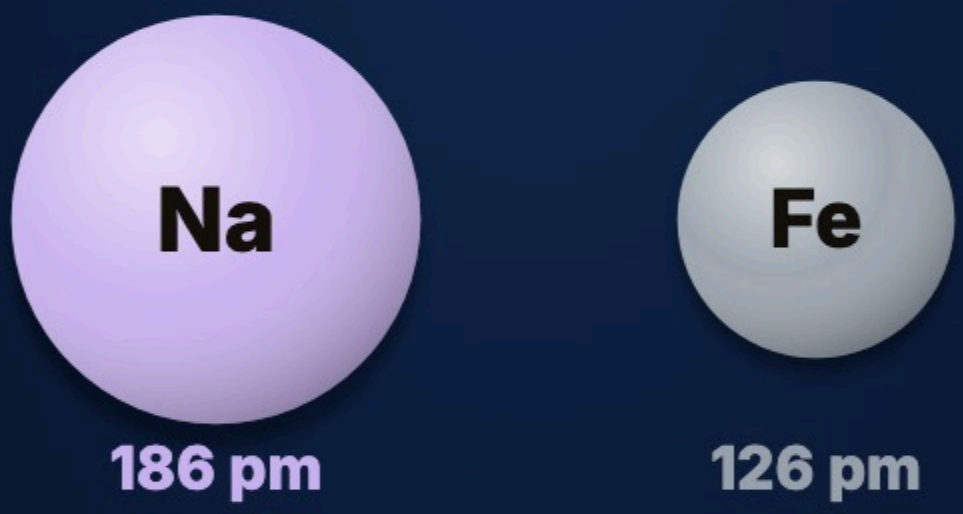
Cr, V, W, Mo, Mn → steels and **stainless steel**.

Transition + non-transition metals: **brass** (Cu–Zn), **bronze** (Cu–Sn).

Remember

small atoms in the gaps → interstitial compound

same-size atoms swap → alloy



Both make a metal **harder**.

Your turn: Na (186 pm) and Fe (126 pm): will they form an alloy easily?