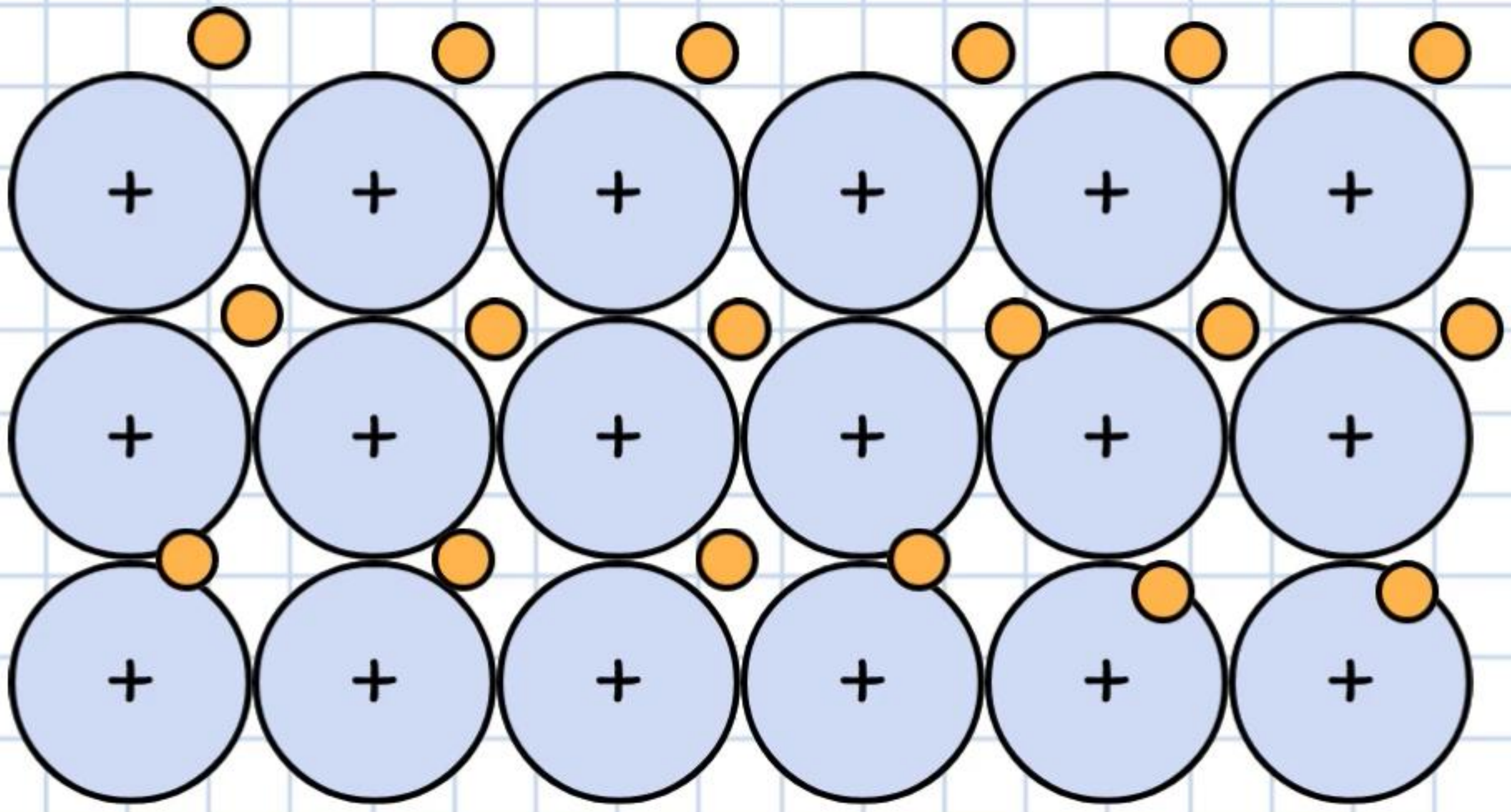
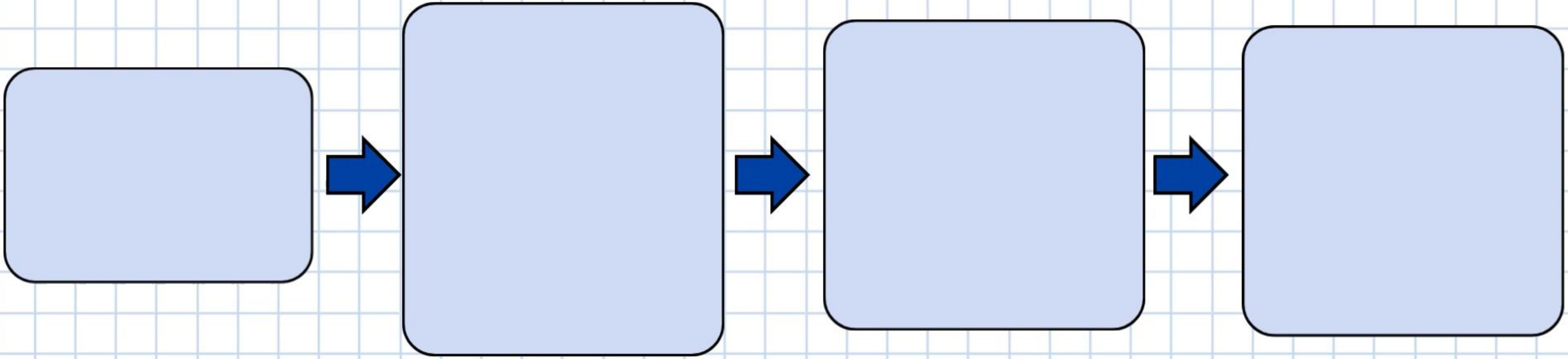
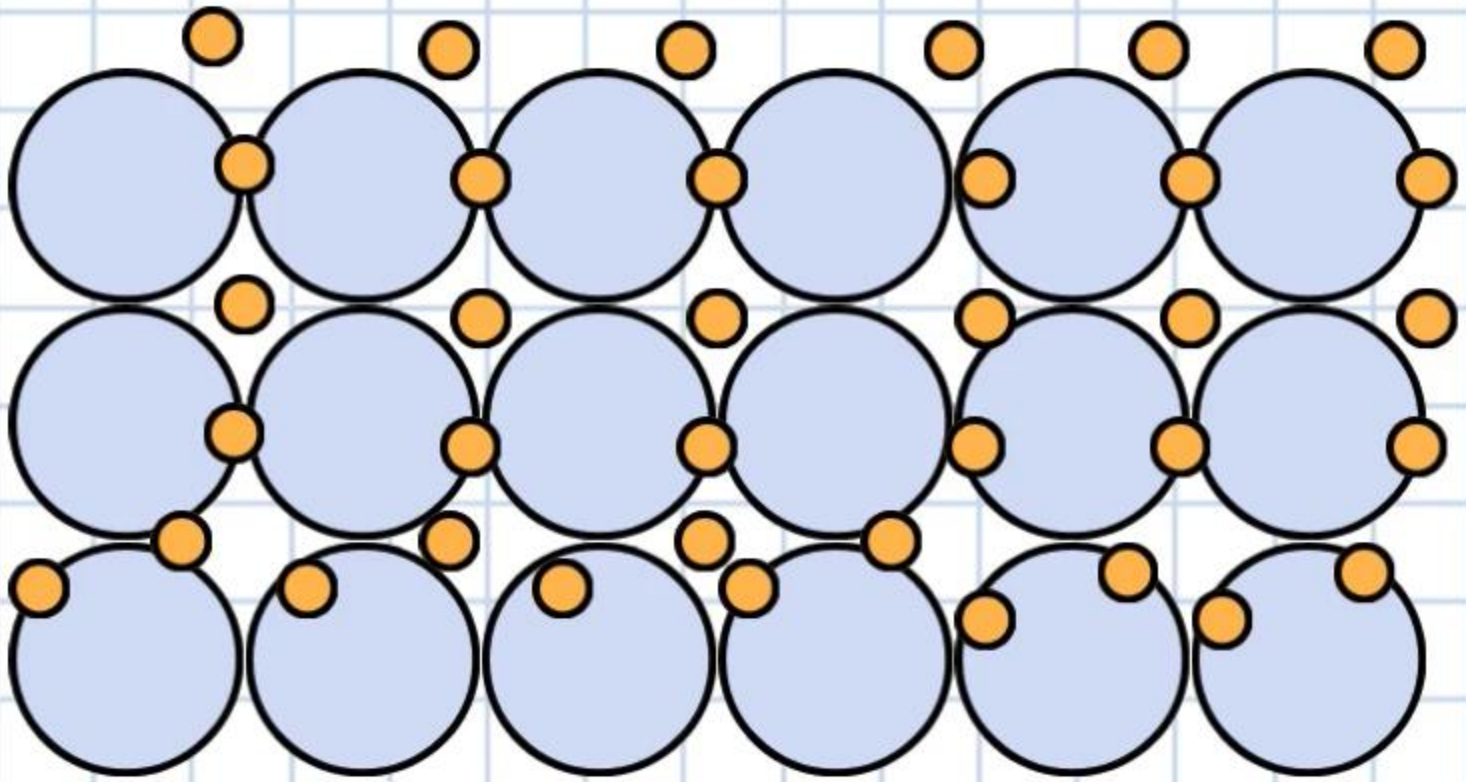
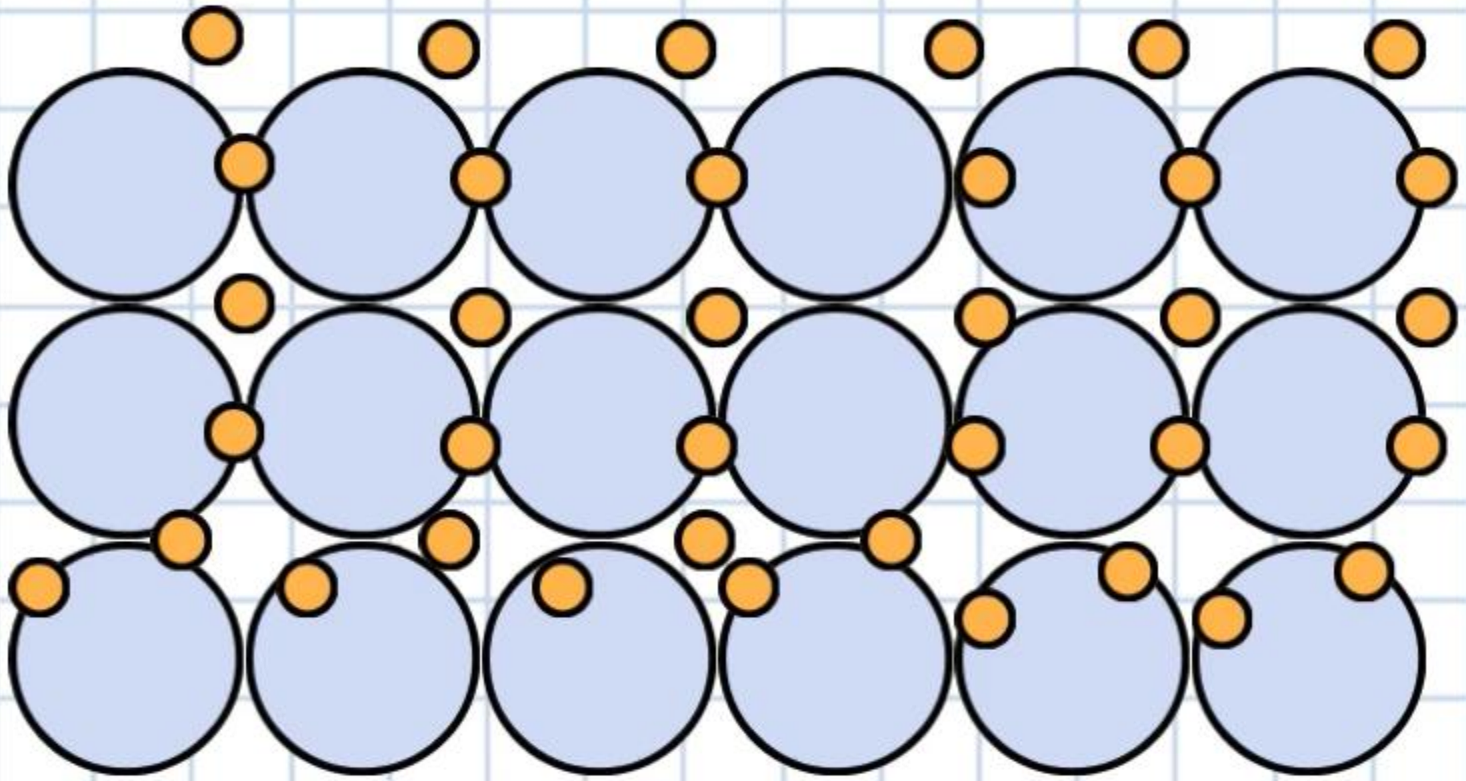
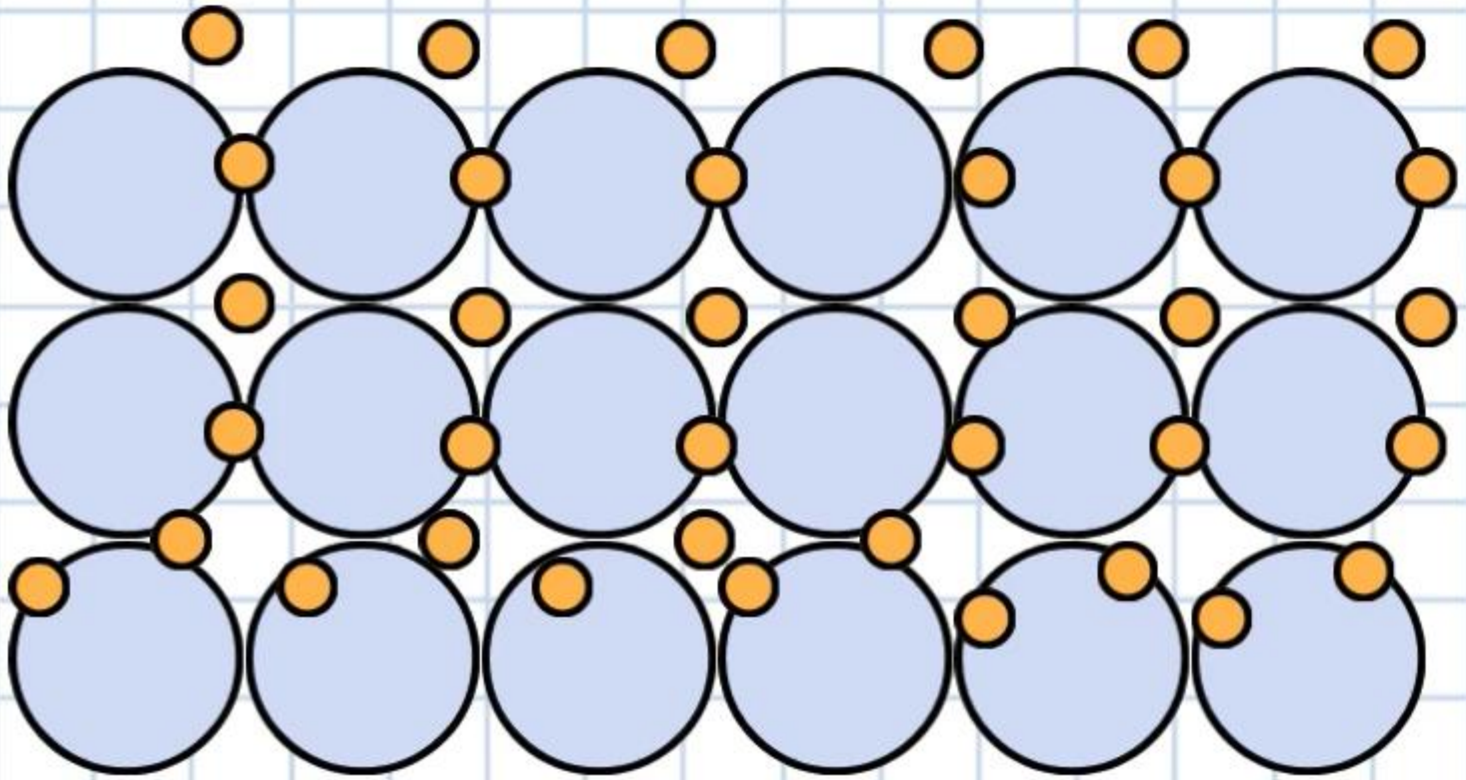
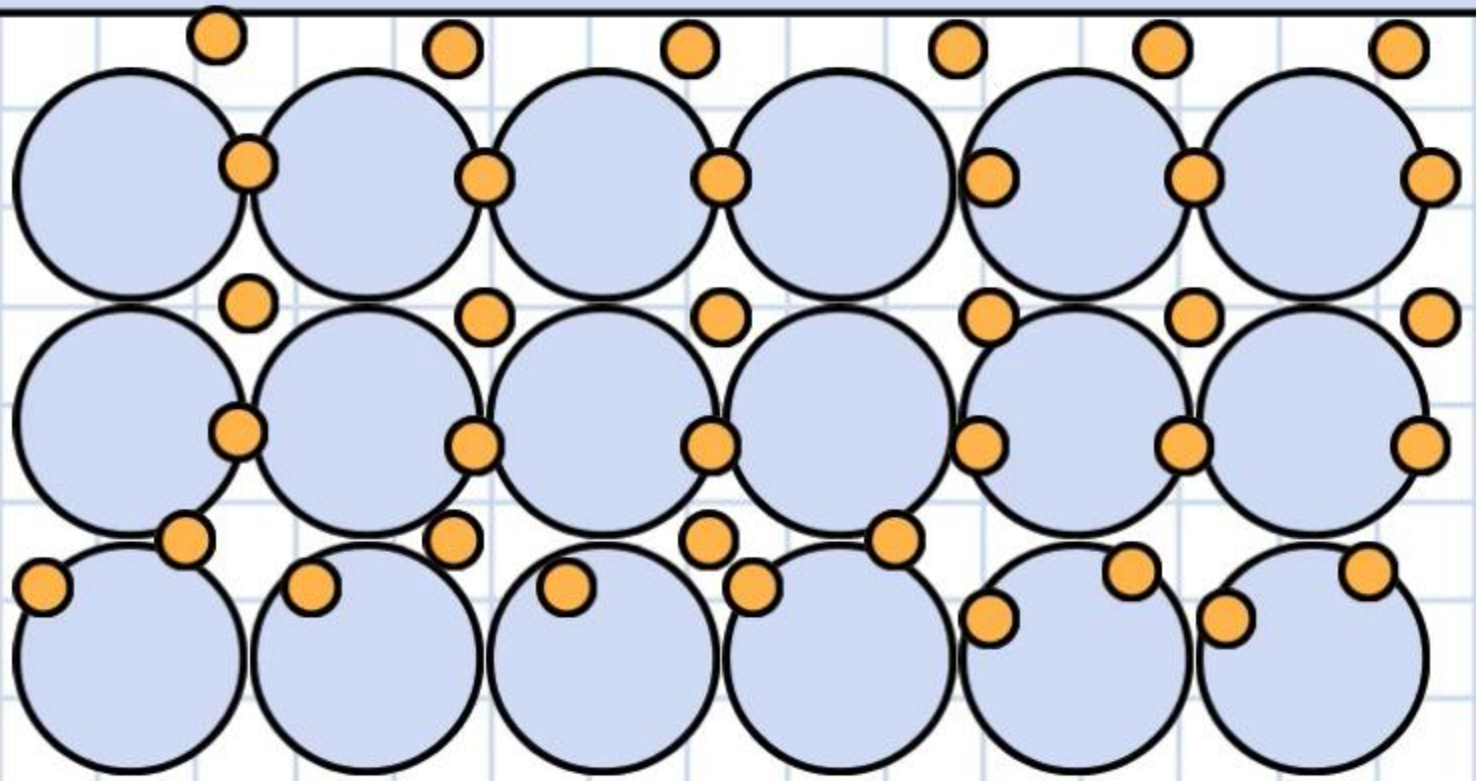


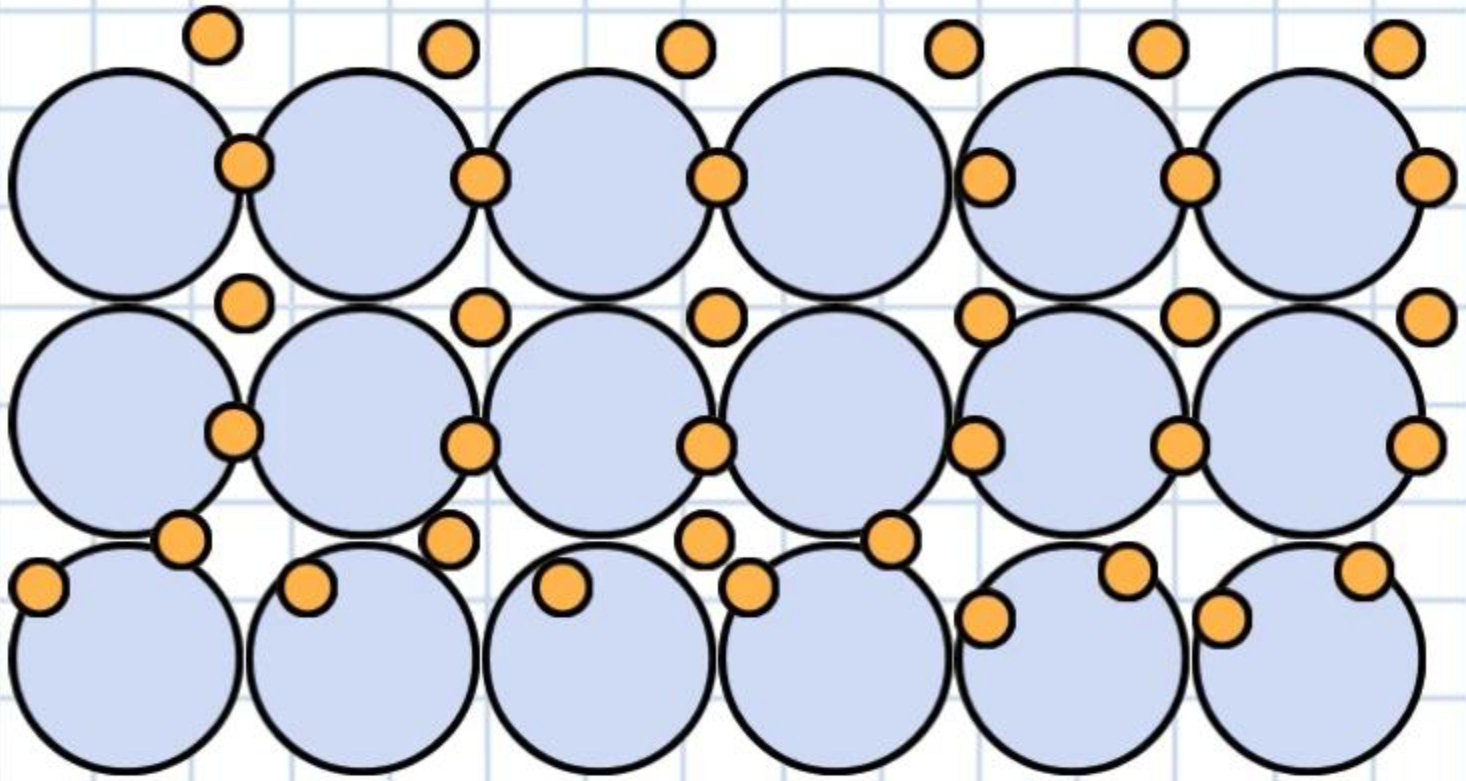


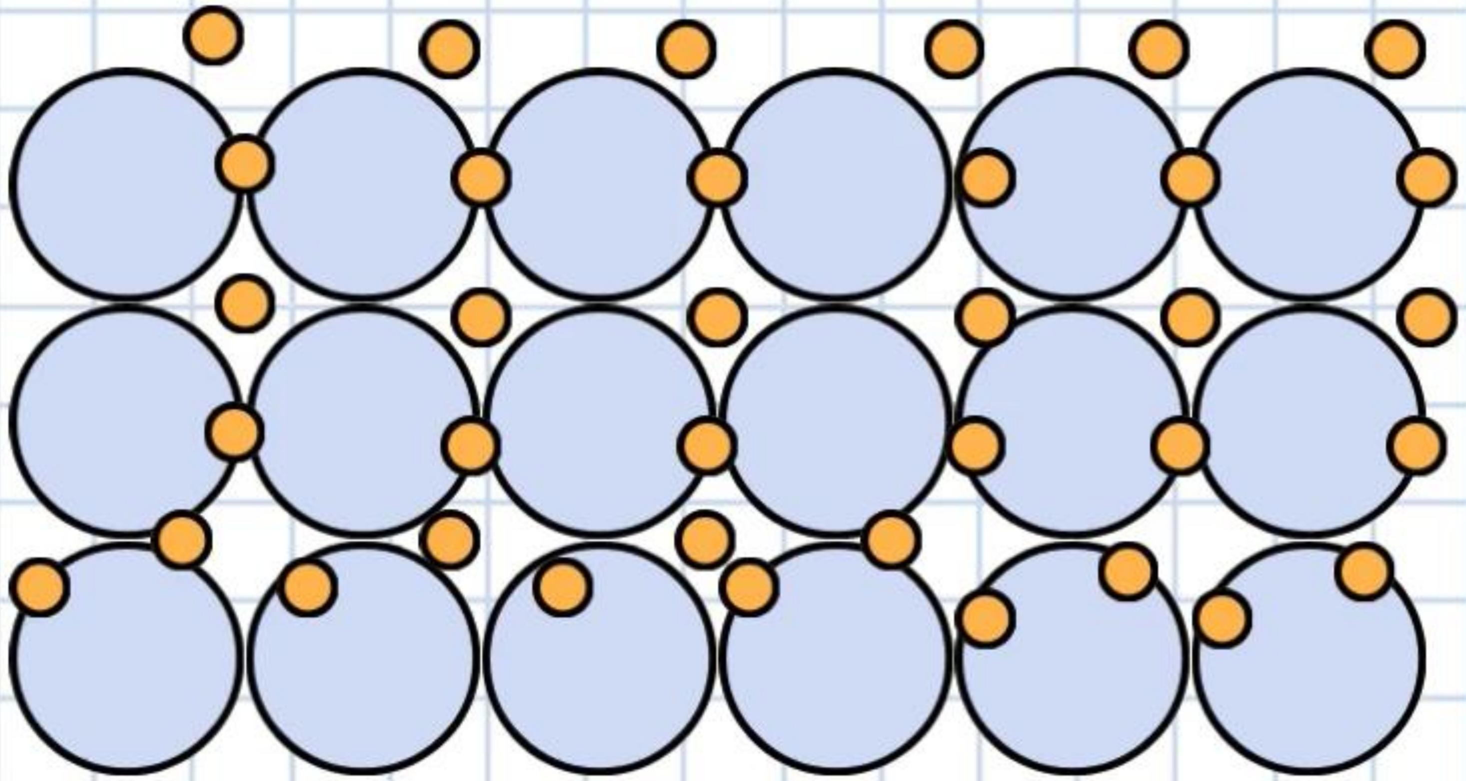


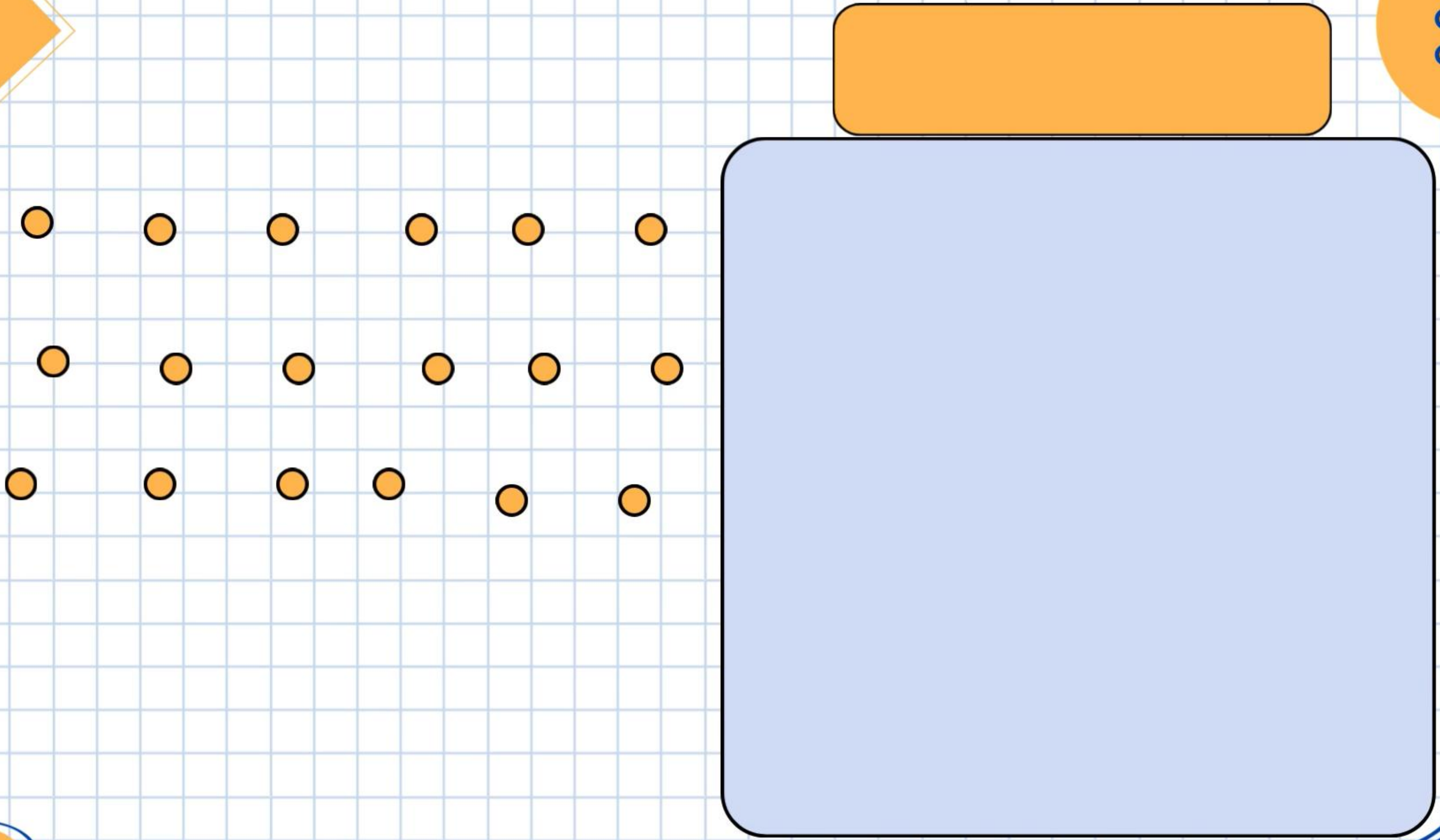


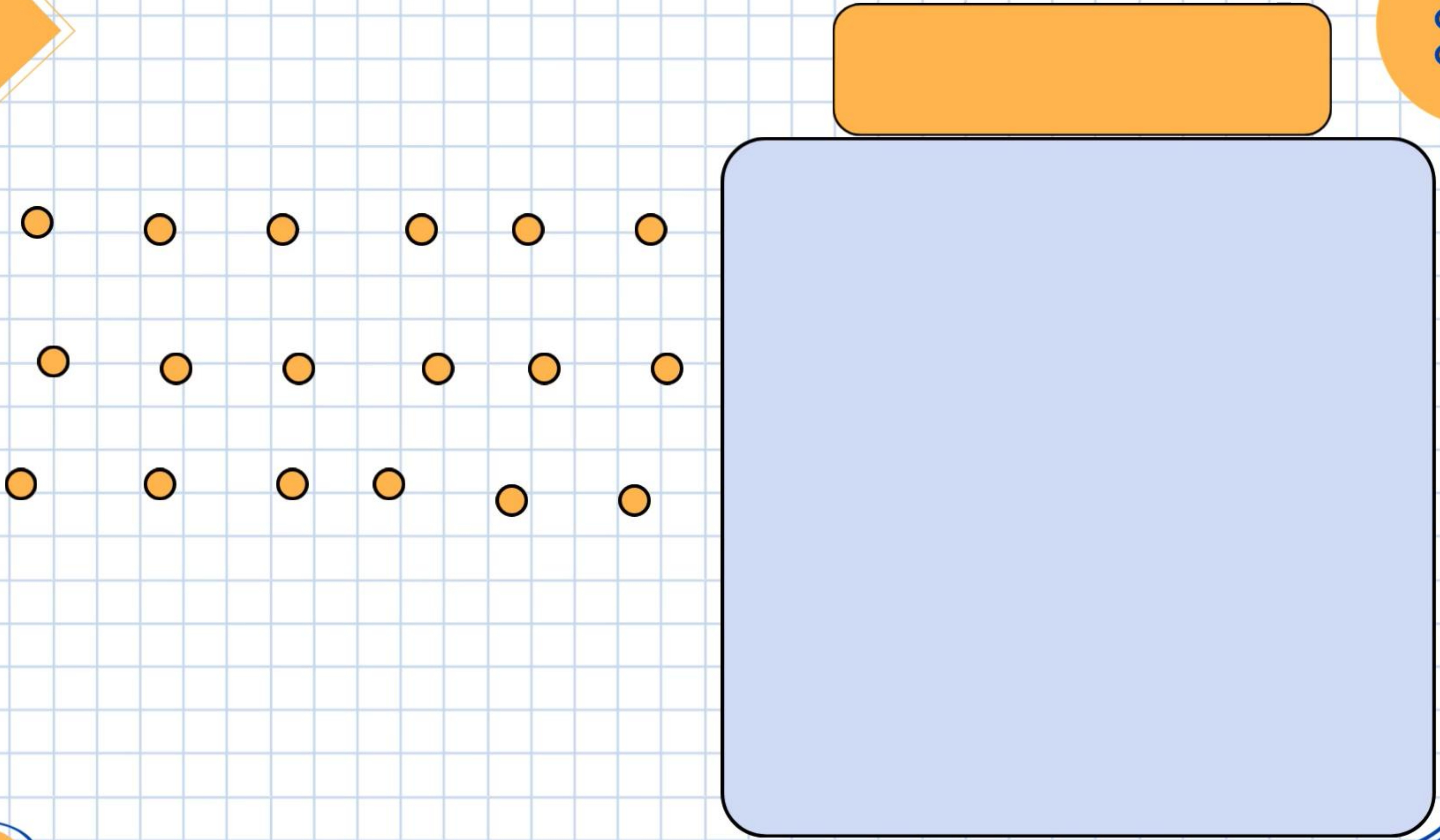






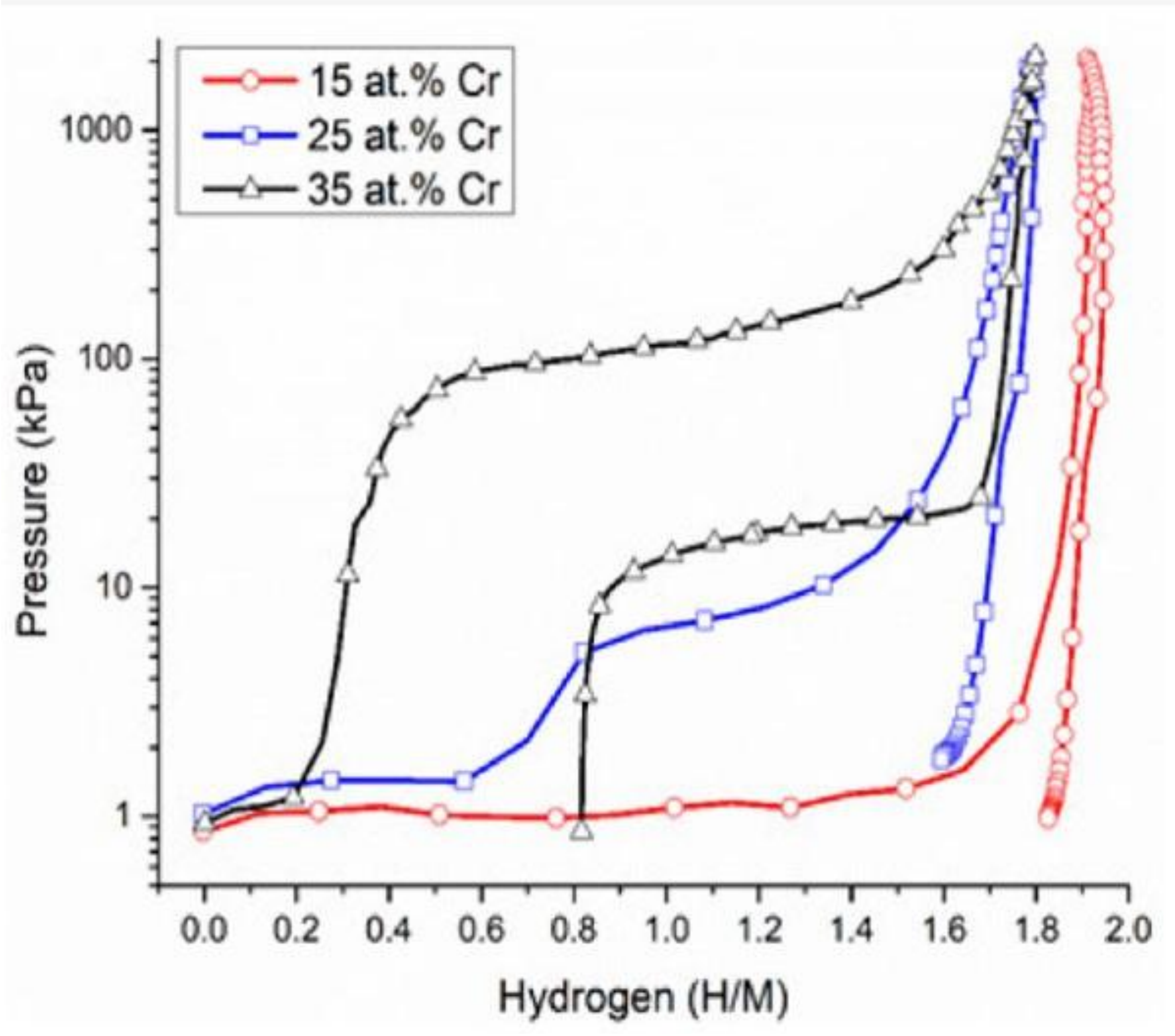






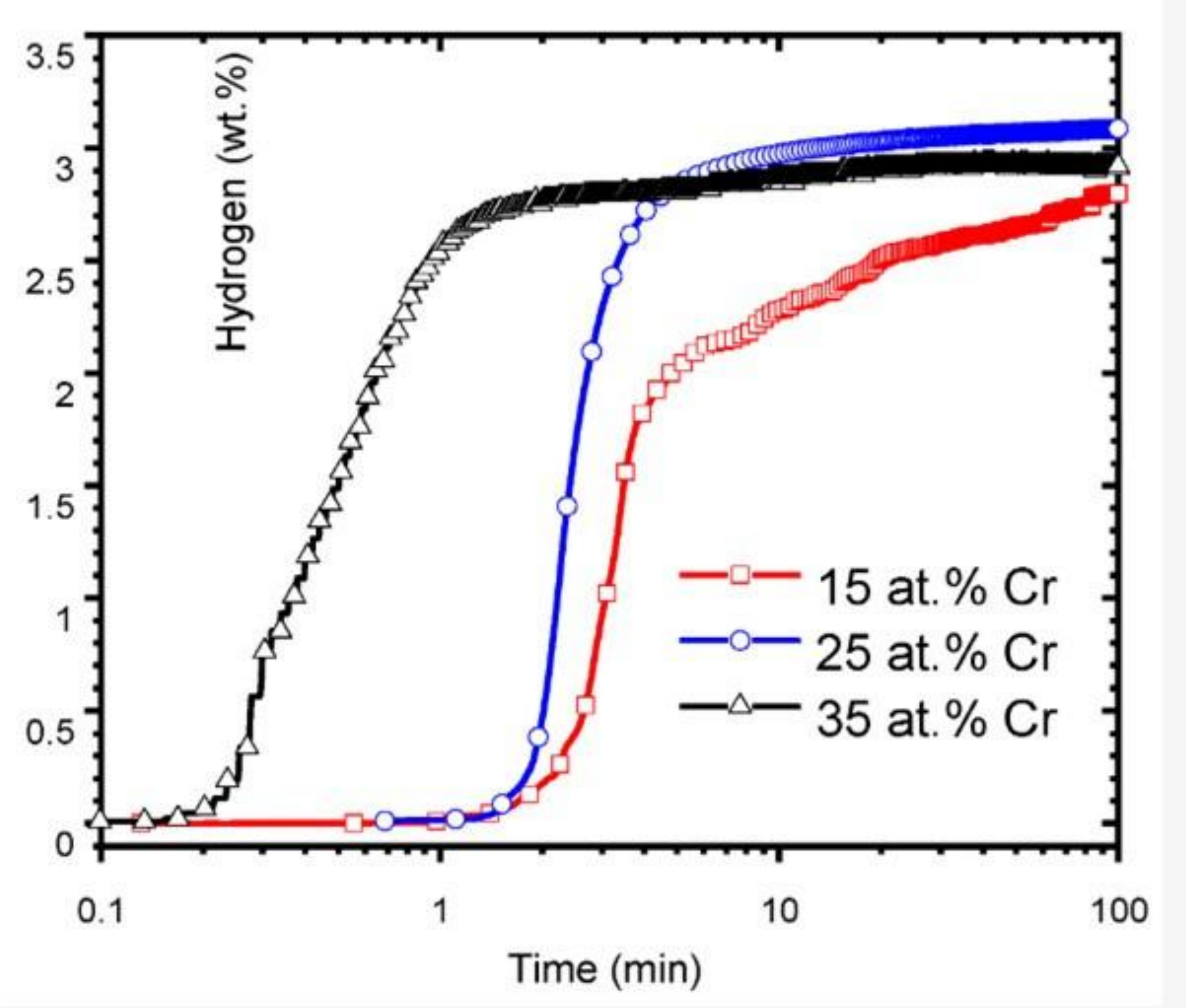
The Effect of Adding Cr to Ti-V-Nb-Based HEAs

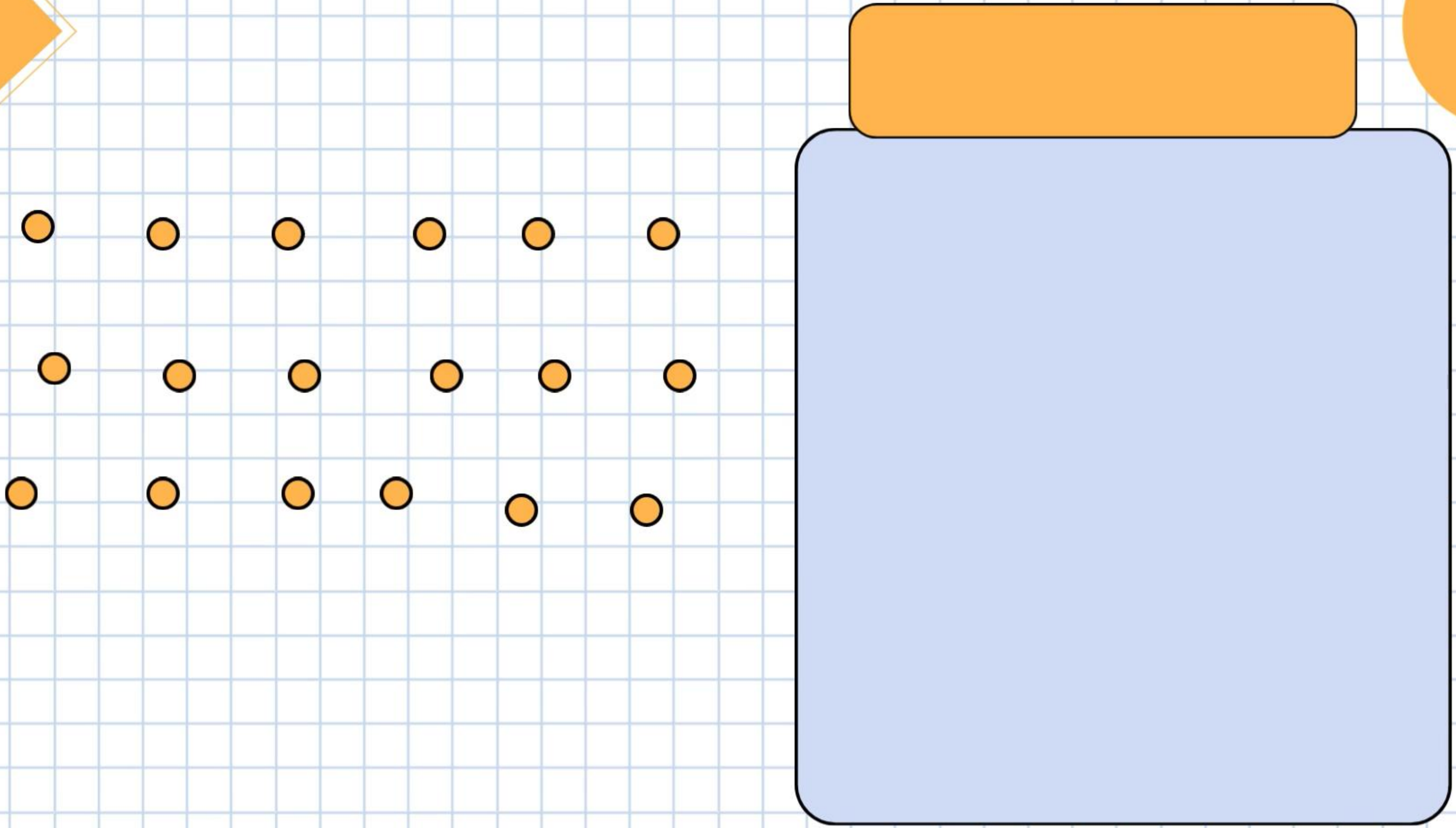
Experimental and CALPHAD-based studies investigated how the addition of Cr (x = 15, 25, 35 at.%) to the Ti-V-Nb alloy system affects its hydrogen storage properties. The results show that increasing the Cr content significantly raises the equilibrium plate pressure of the alloy but does not significantly affect the maximum hydrogen capacity.

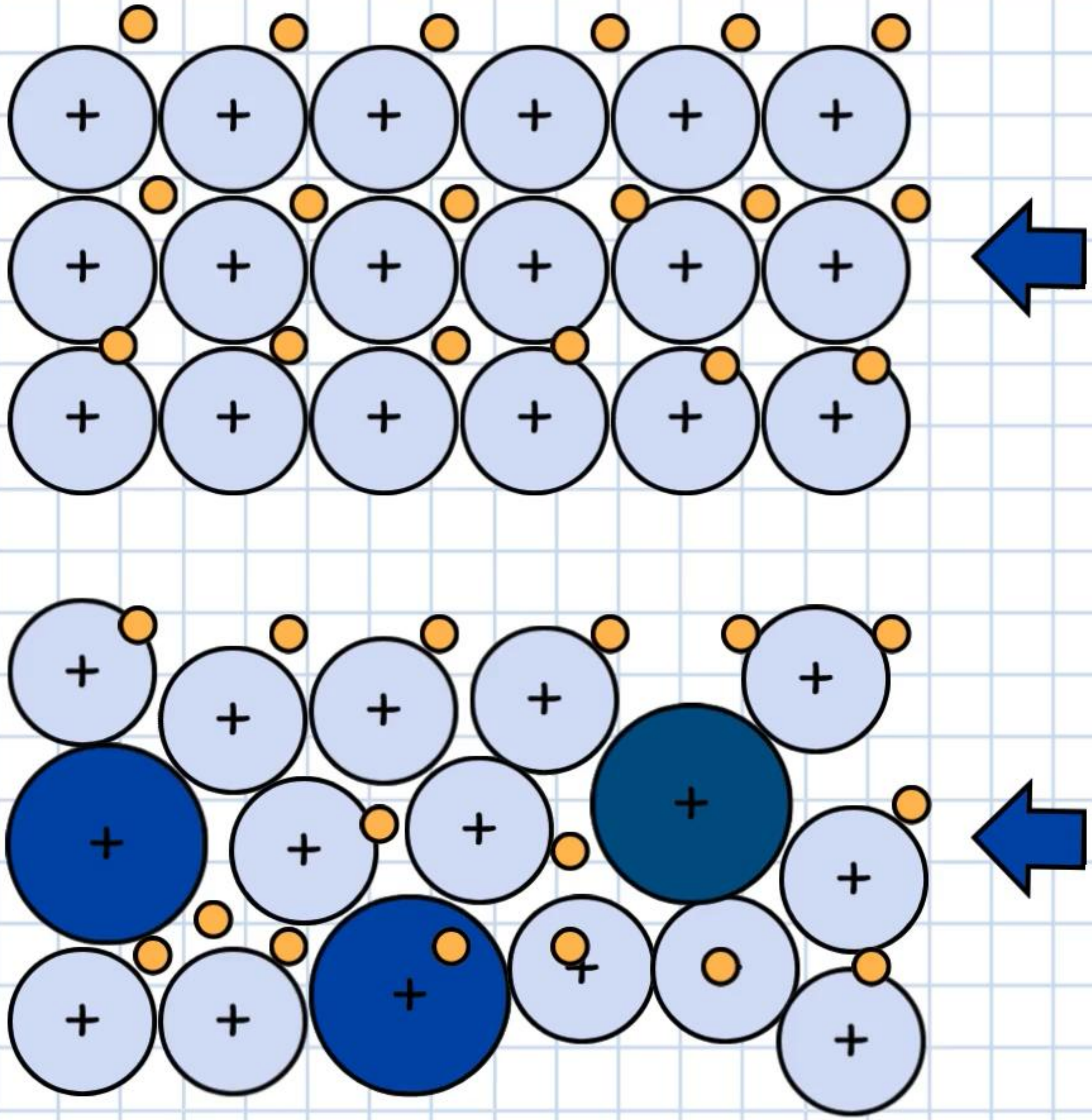


The Effect of Adding Cr to Ti-V-Nb-Based HEAs

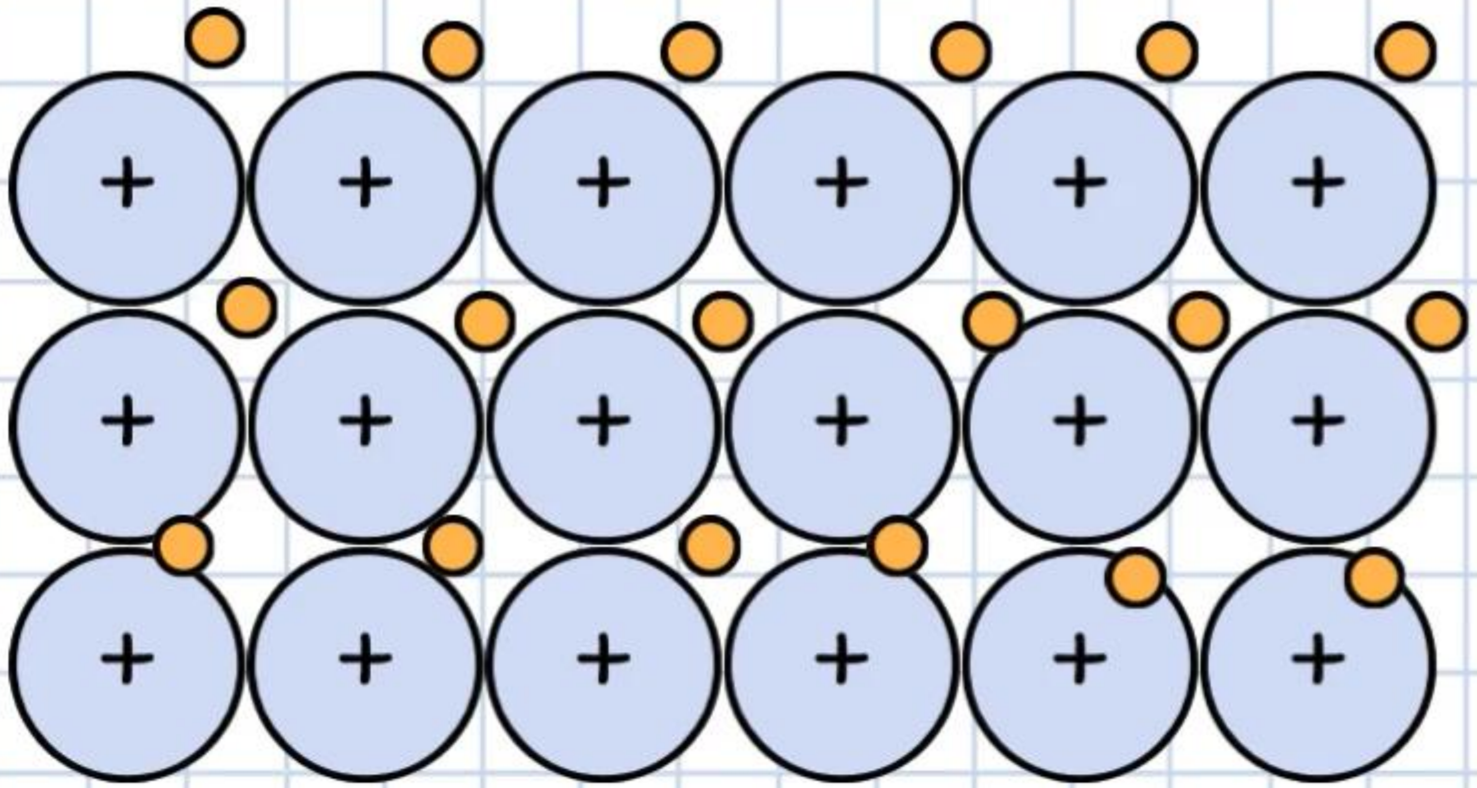
This indicates that increasing the proportion of a non-hydrogen-binding element such as Cr has the potential to improve the reversibility of the alloy without causing a significant loss in capacity [7].

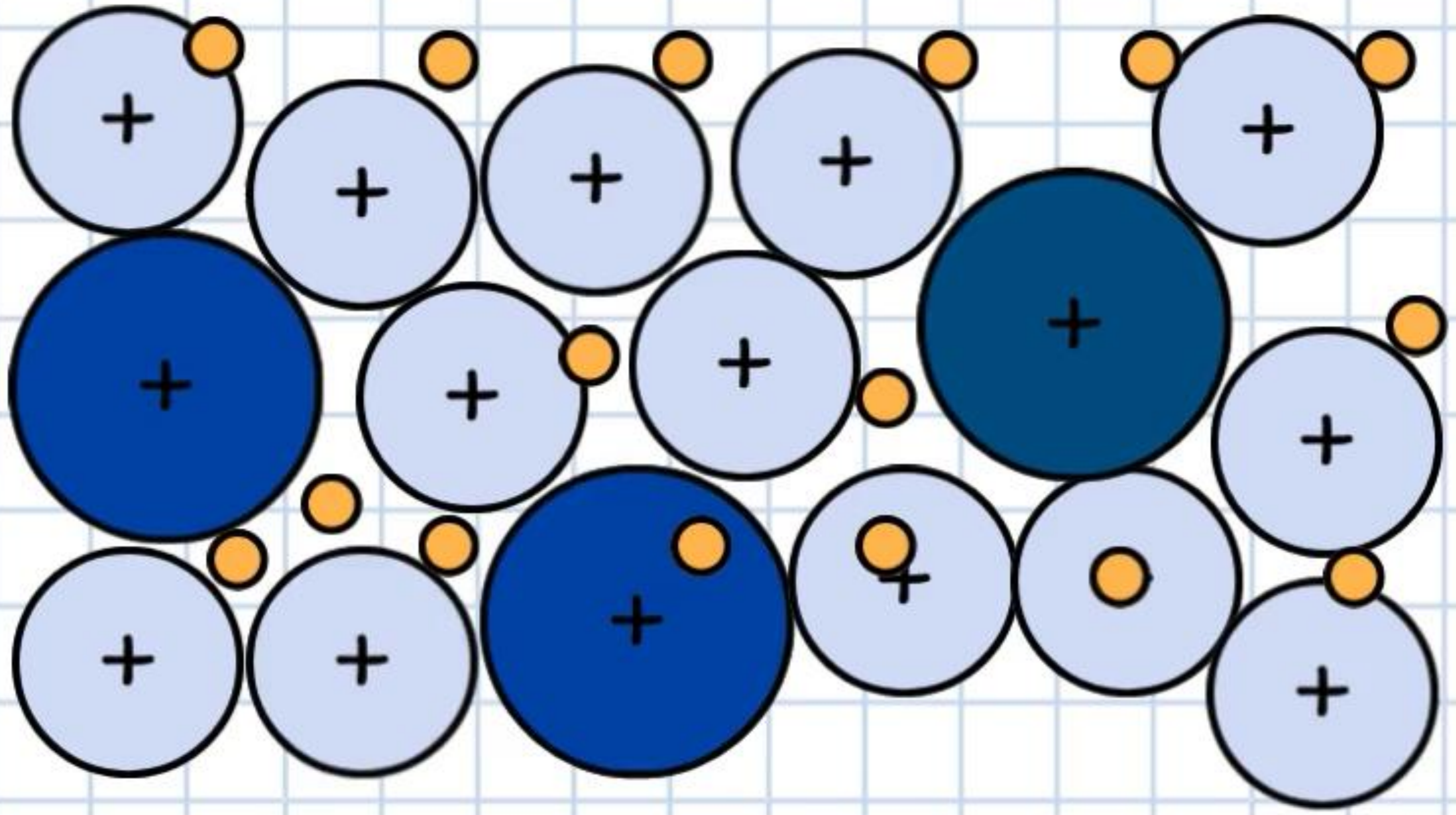




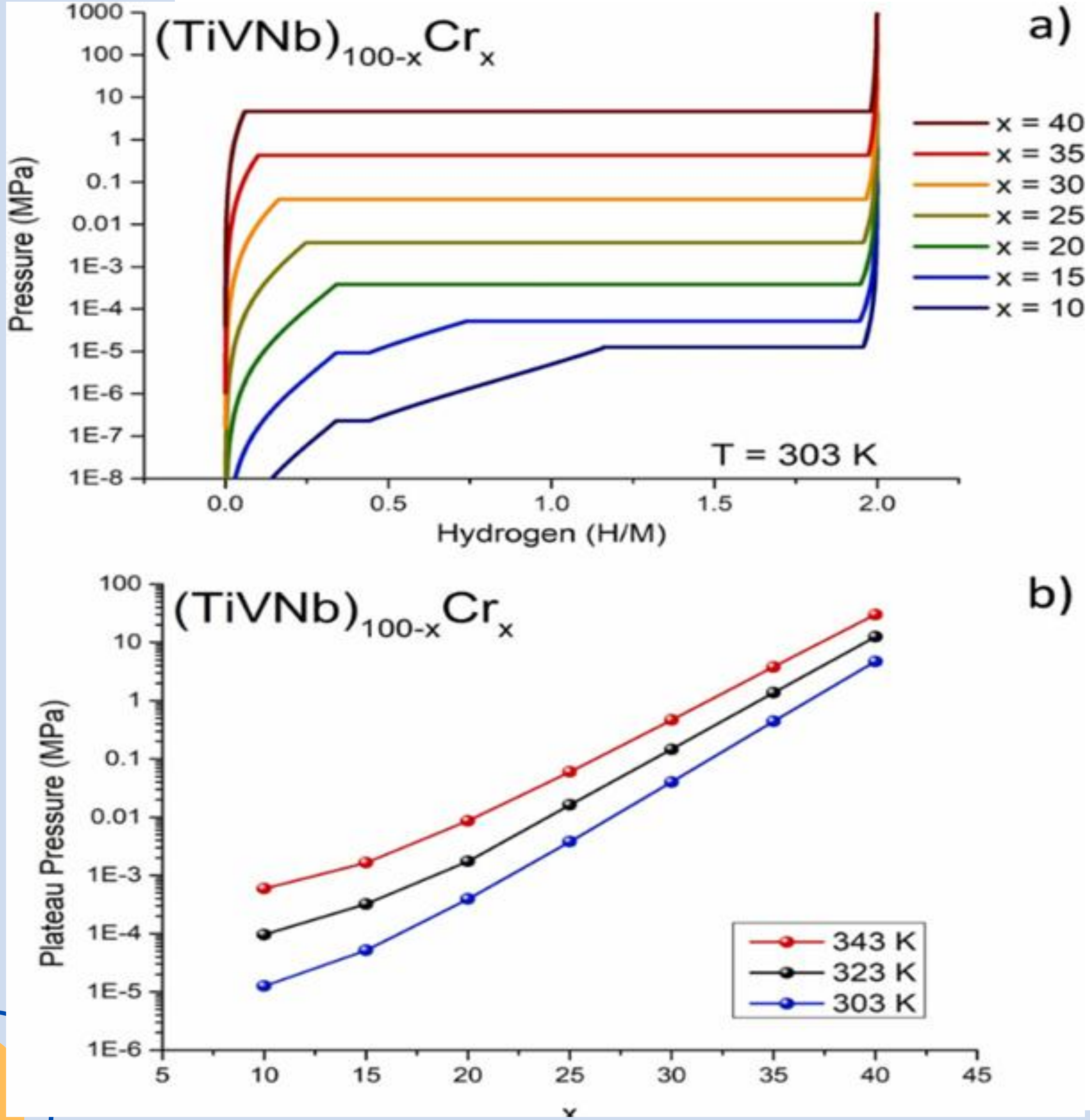


In another study, the effect of Cr content on the hydrogen storage properties of Ti-V-Nb-Cr alloys is investigated. Alloys containing x = 30 and 35 at.% Cr exhibit a single-phase BCC structure, while the alloy containing 40 at.% Cr exhibits a high proportion of C15 Laves phase.





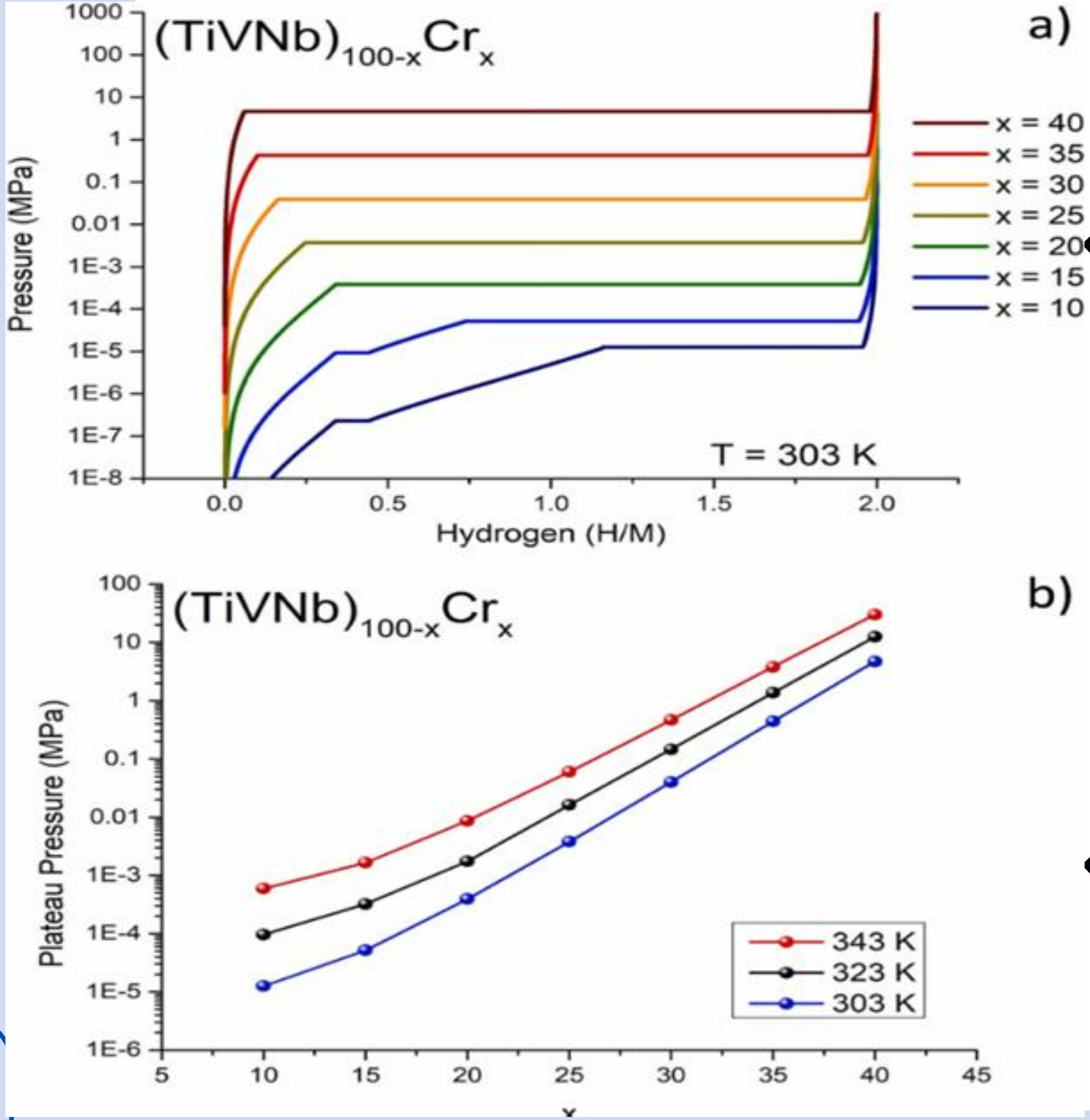
BCC-phase alloys achieve a capacity of approximately H/M ≈ 2 by rapidly absorbing hydrogen at room temperature. In contrast, the 40% Cr alloy, where the C15 phase is dominant, exhibits a low capacity (~1 wt.%).



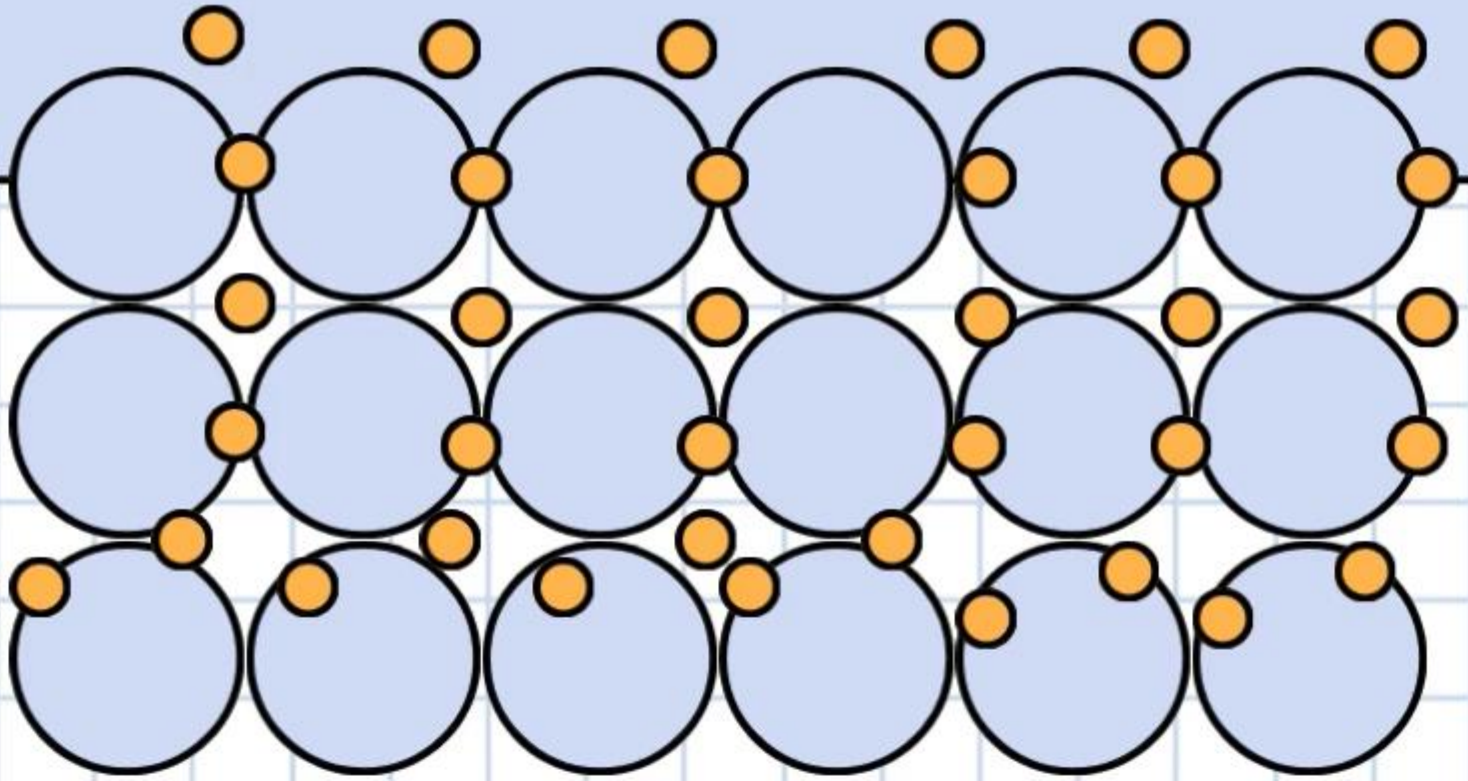
TiVNbCr metal hydride family

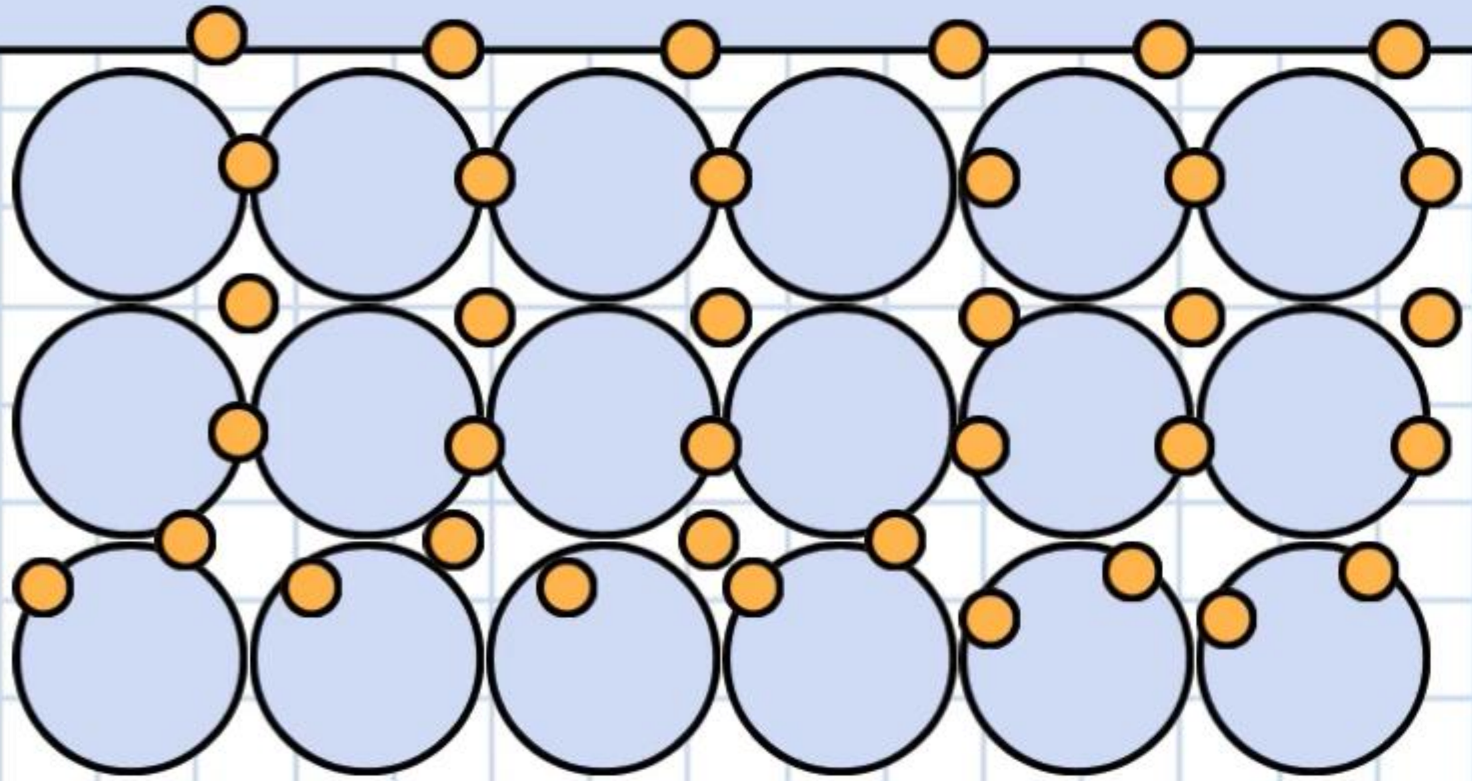
Plateau pressure calculations and experimental PCT measurements show that the equilibrium pressure increases as the Cr content increases, indicating a decrease in the system's thermodynamic stability. Thus, the (TiVNb)70Cr30 and (TiVNb)65Cr35 alloys can provide reversible hydrogen storage (approximately H/M ≈ 1) under conditions close to room temperature.

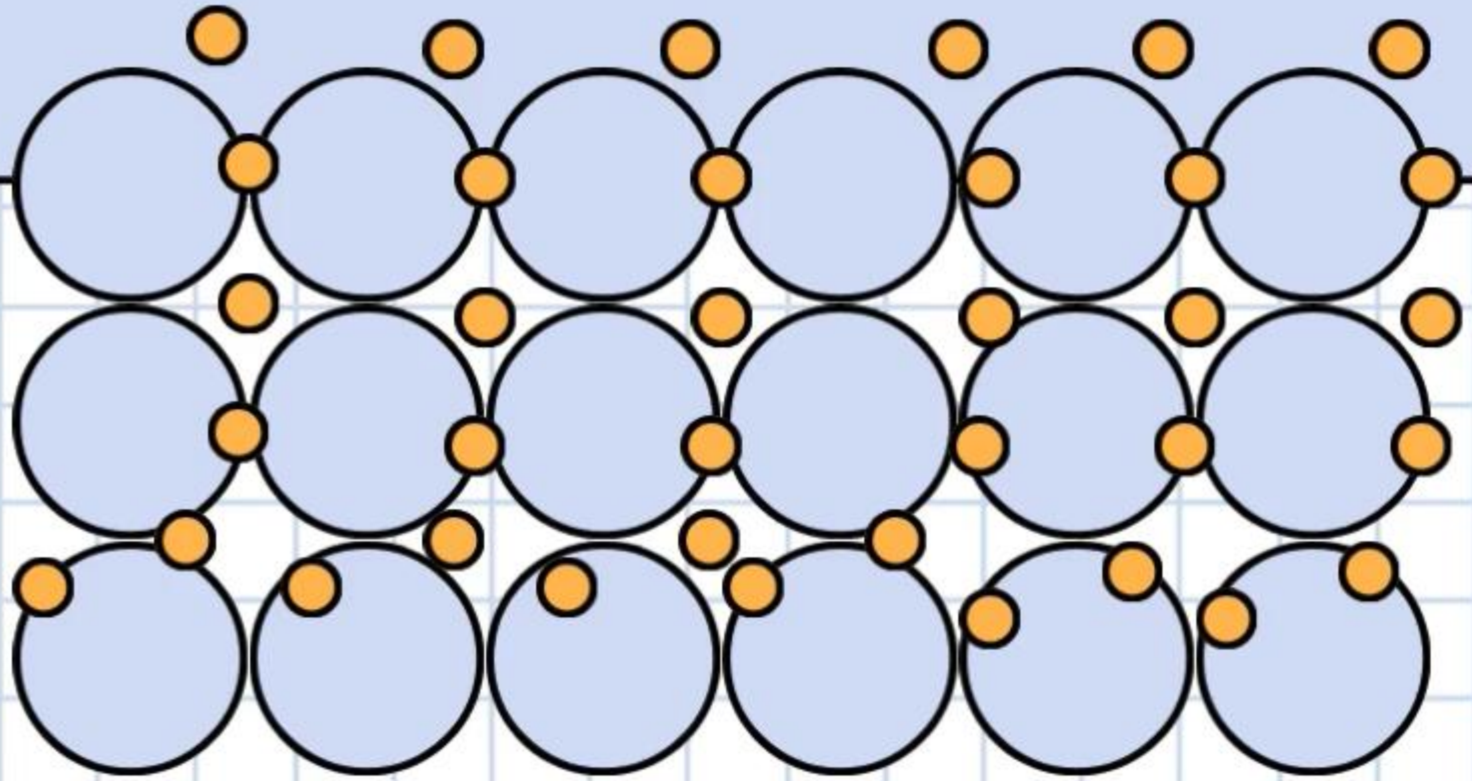
TiVNbCr metal hydride family



The study demonstrates that BCC high-entropy alloys can be optimized for hydrogen storage applications by carefully adjusting the Cr content [9].



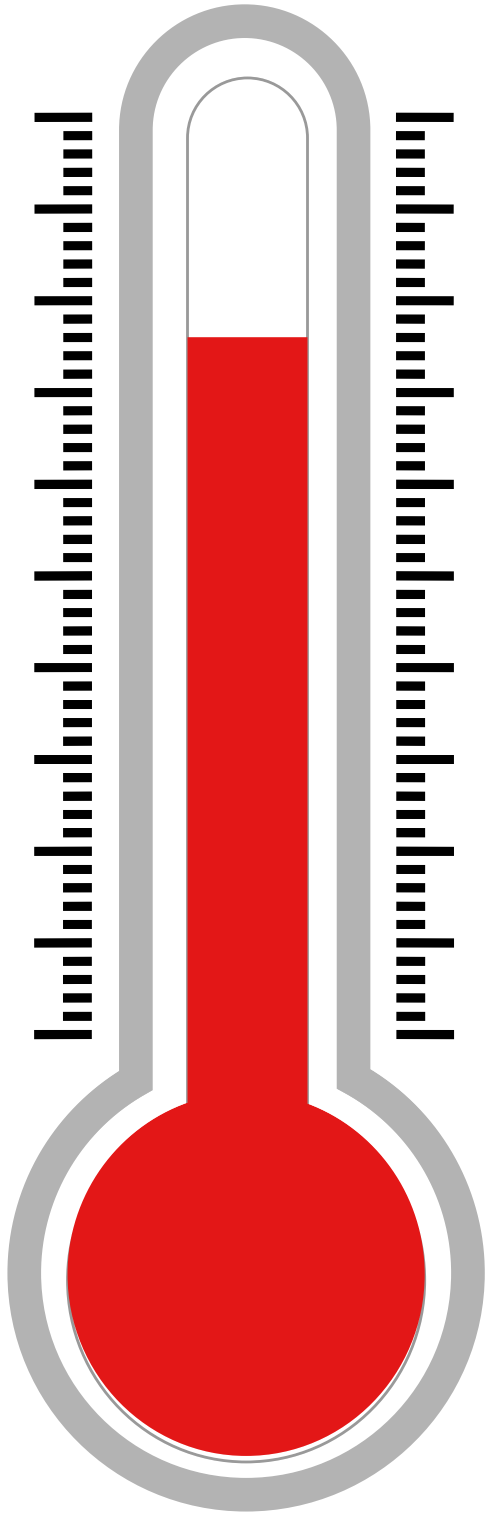


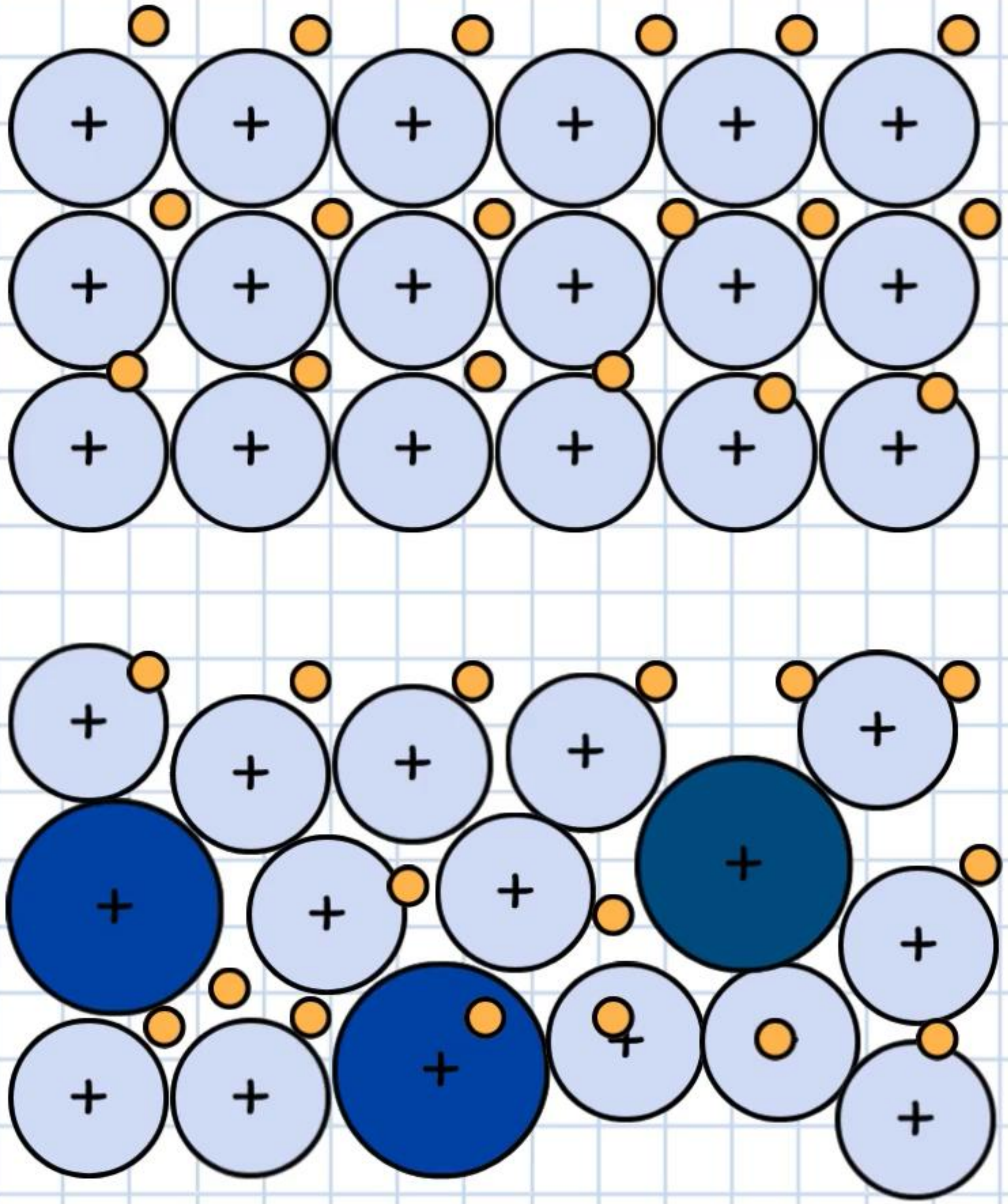


Activation Values

	Cu 2.5	Cu 15
Activation time (h)	2	10
Activation Temp. (°C)	350	350

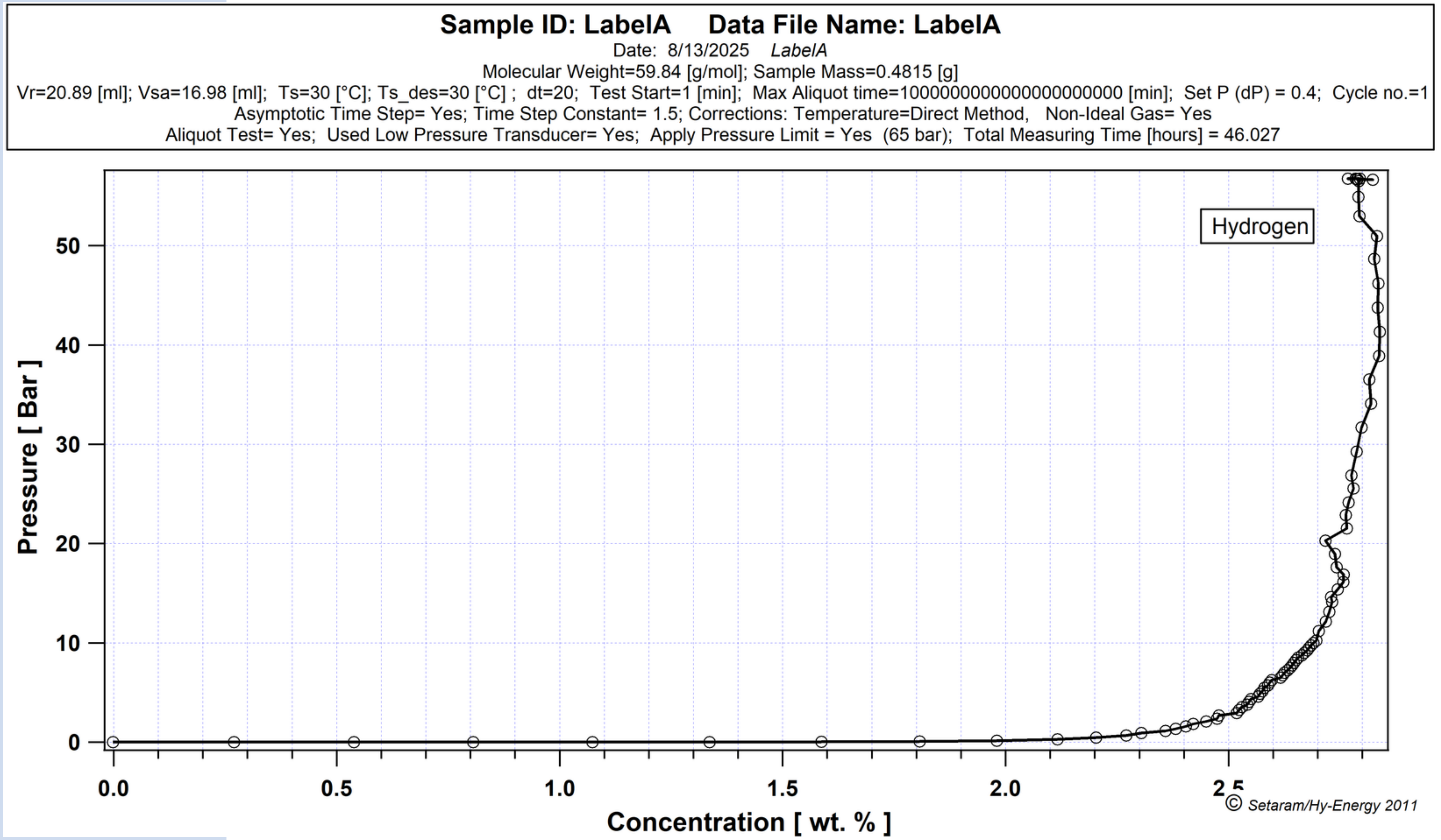
It appears that the (Cu15) sample is more difficult to activate, which is likely due to the higher Cu content on the surface and its passivation.

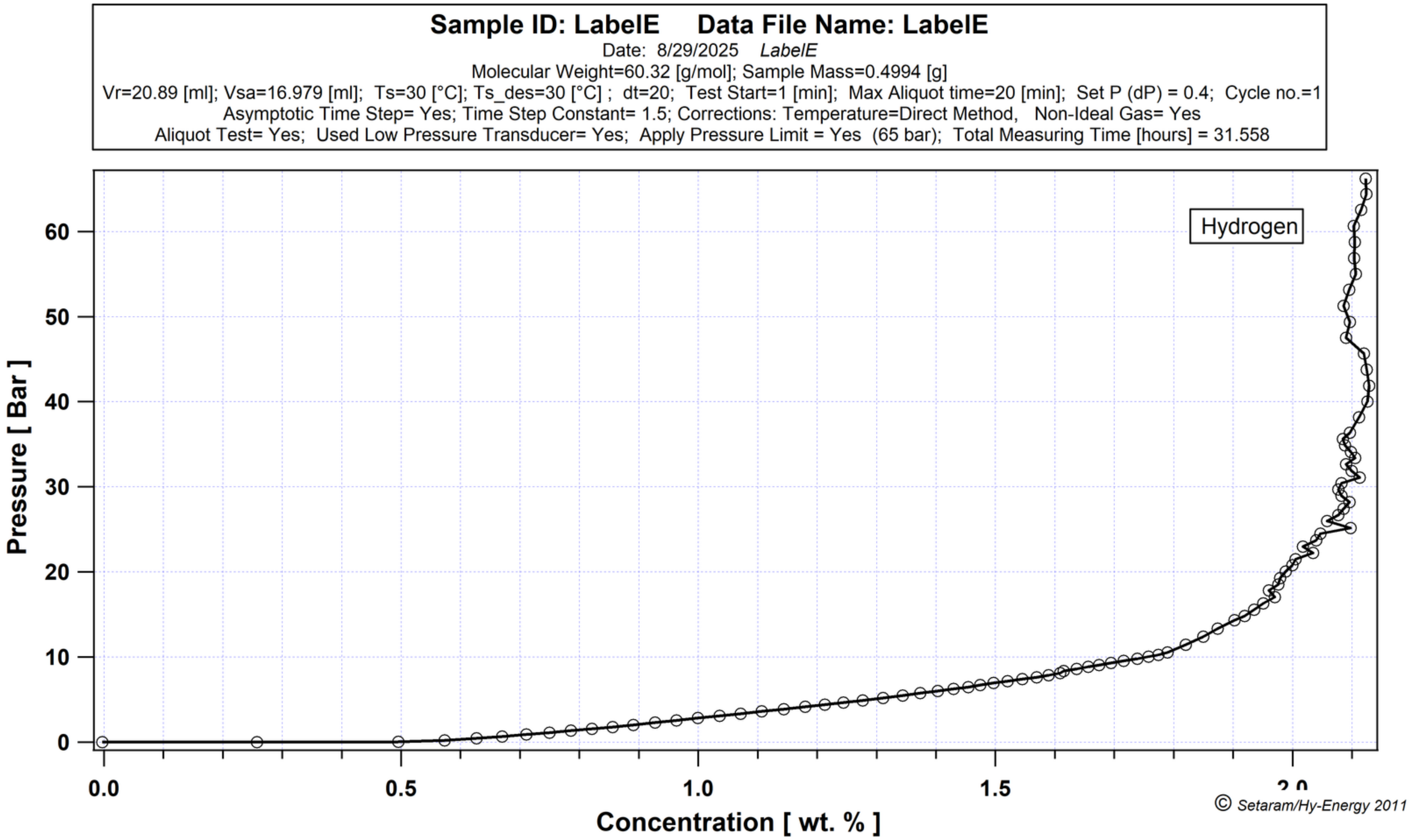




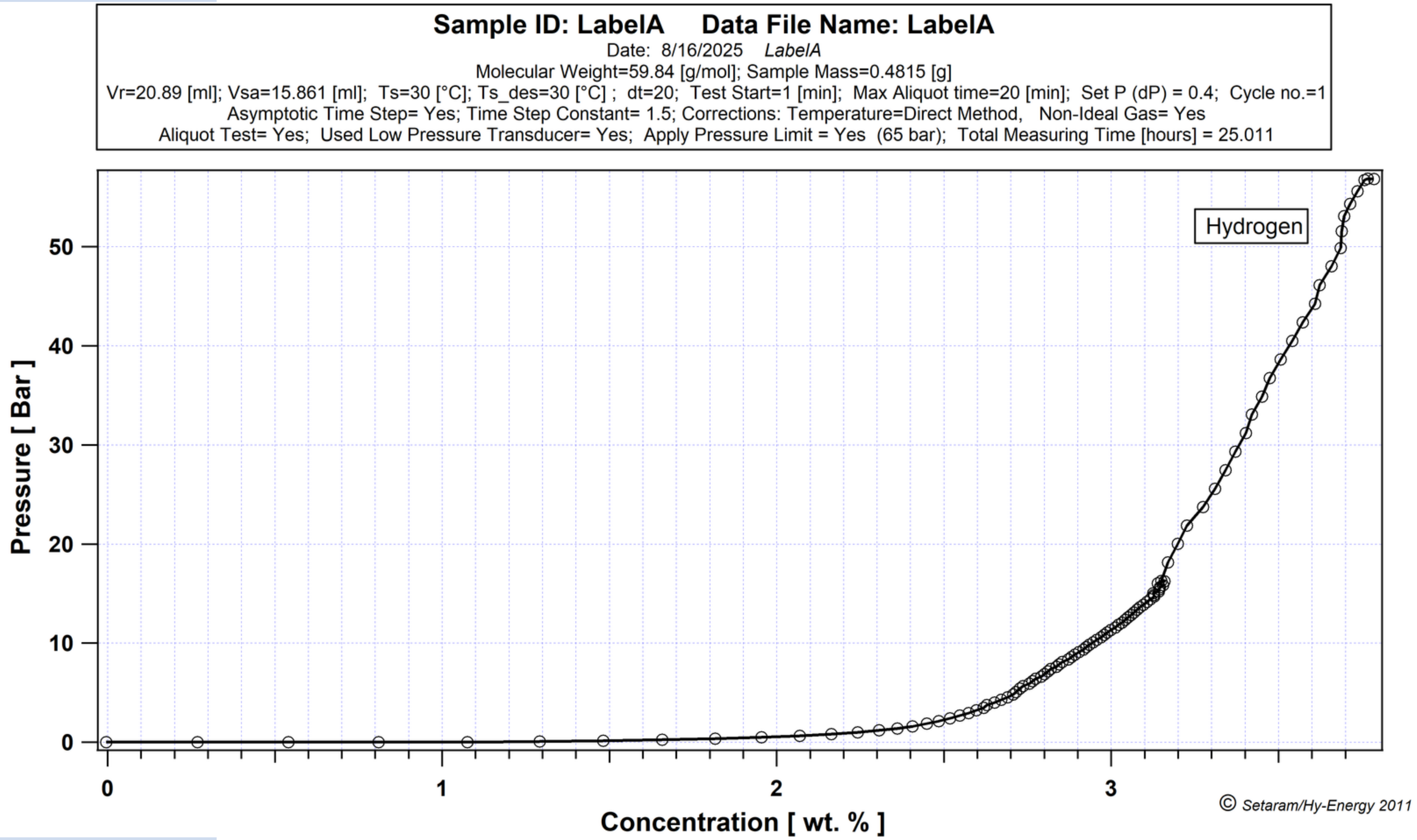
		Cu 2.5 (%wt)	Cu 15 (%wt)
Before Activation	30° C	-0,024	0,258273
	100 °C	0,827062	0,54865
	275 °C	0,486322	0,495151
After Activation	30° C	2.64359	1.79909
	100 °C	2.09652	1.2127
	275 °C	1.13807	0.954055
PCT	30° C	2.8391	2.12884
	100 °C	3.78546	1.56625

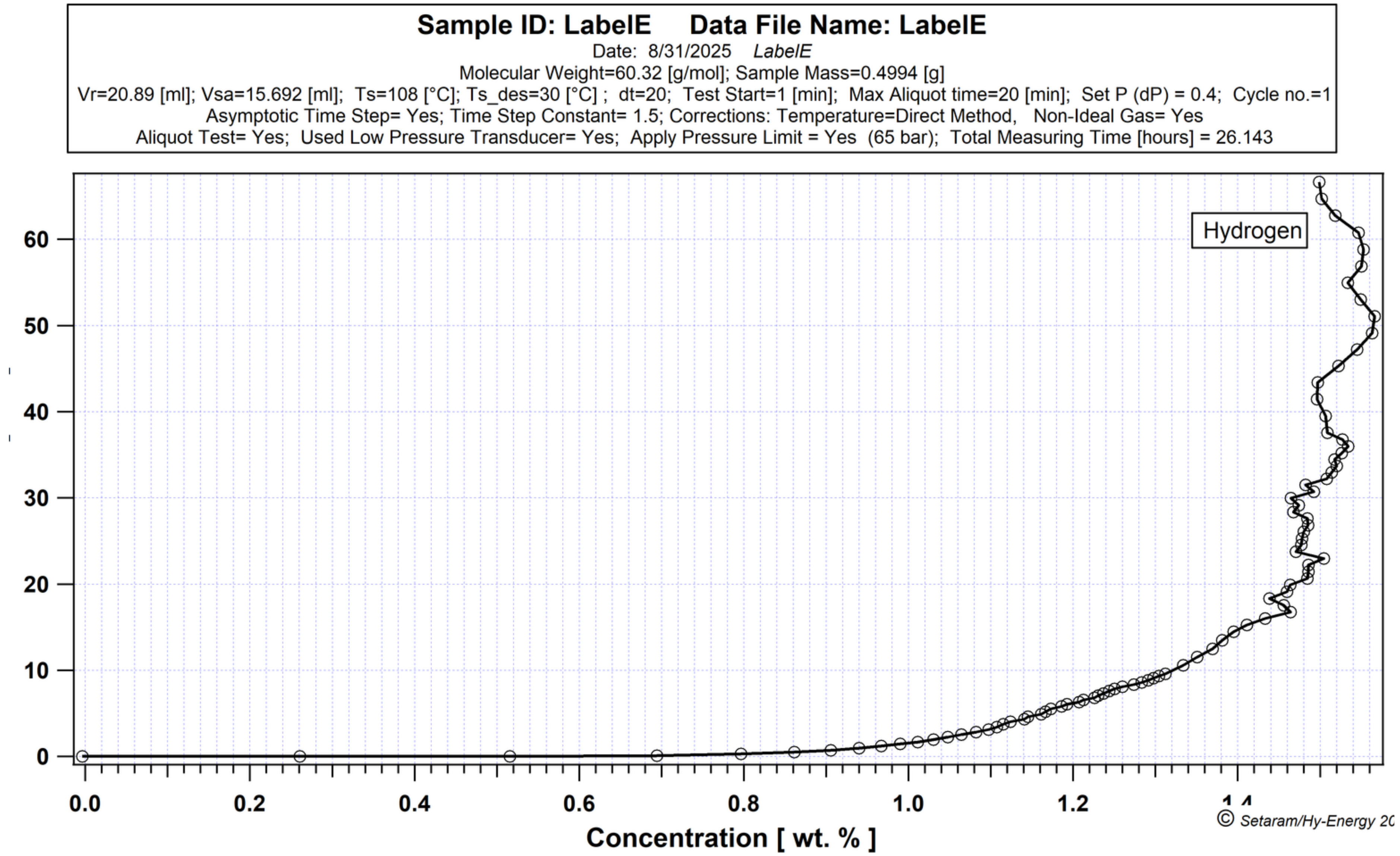
PCT Graph at 30 Degrees





PCT Graph at 100 Degrees





Conclusions

Low Cu alloy (Cu 2,5):

- Higher capacity after activation (≈ 2.8 wt.% at 30 °C, ≈ 3.7 wt.% at 100 °C).
- Plateau pressure is at suitable levels, making it more advantageous for reversible hydrogen storage.

High Cu alloy (Cu 15):

- Lower capacity after activation (≈ 2.1 wt.% at 30 °C, ≈ 3.0 wt.% at 100 °C).
- Plateau pressure has increased, meaning the system is less stable but discharging is easier.

Conclusions

Commentary on %Cu

- As the Cu ratio increases: The alloy's hydrogen capacity decreases, but the equilibrium (plateau) pressure increases.
- This means: Higher Cu → lower capacity, easier desorption.
- Lower Cu → higher capacity, more stable storage.

Thus, %Cu emerges as the key parameter that adjusts the alloy's capacity–stability balance.

Conclusions

(Cu % → activation)

Although oxygen is detected on the surface, this is mostly a thin passivation layer that can be removed by activation under vacuum and at high temperatures. This explains why Cu2.5 achieves a higher sorption capacity (2.64 wt.%) and faster kinetics compared to Cu15 after activation.

Thanks to...

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