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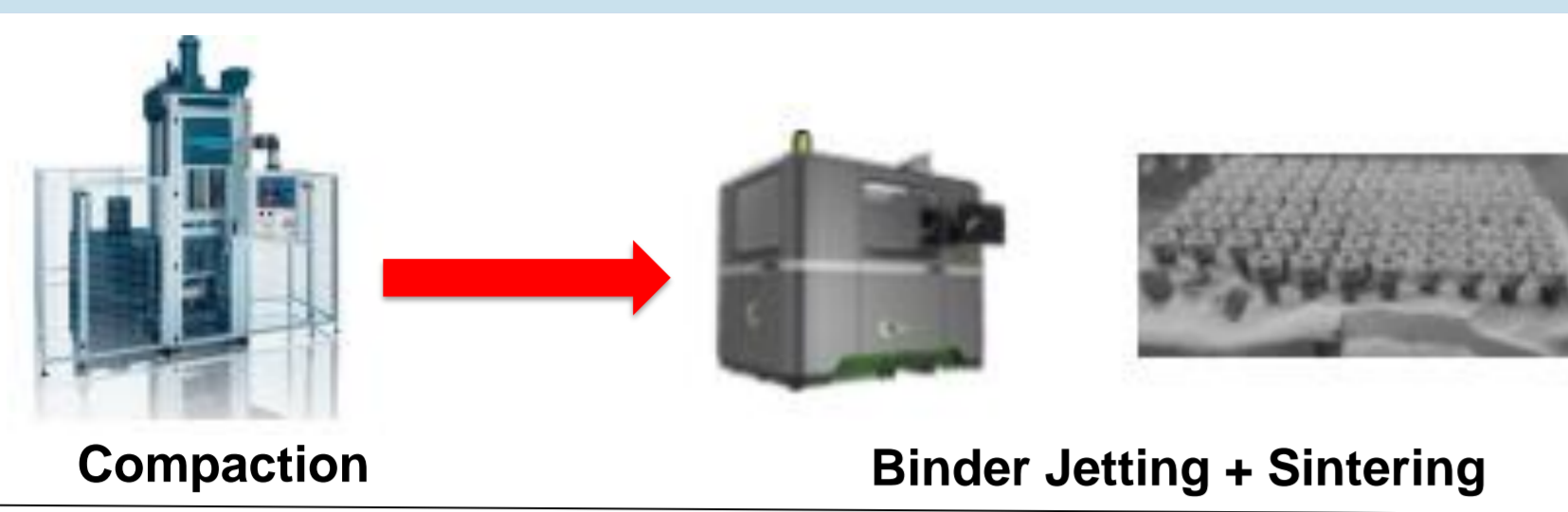
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# 3D printing of WC-Co by Binder Jetting : From powder to final parts

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### Why changing process ?



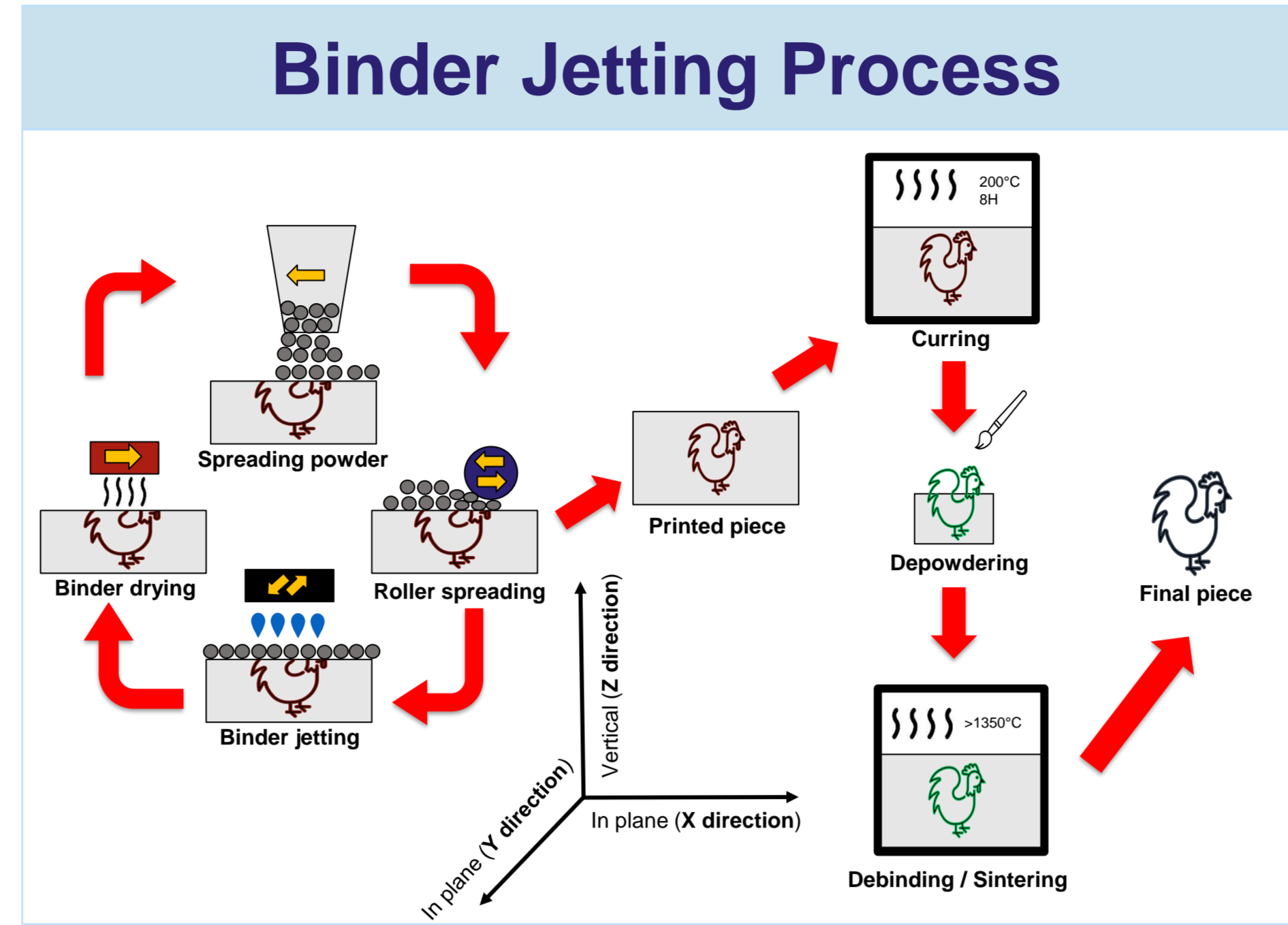
**Compaction** → **Binder Jetting + Sintering**

**B.J. key points**

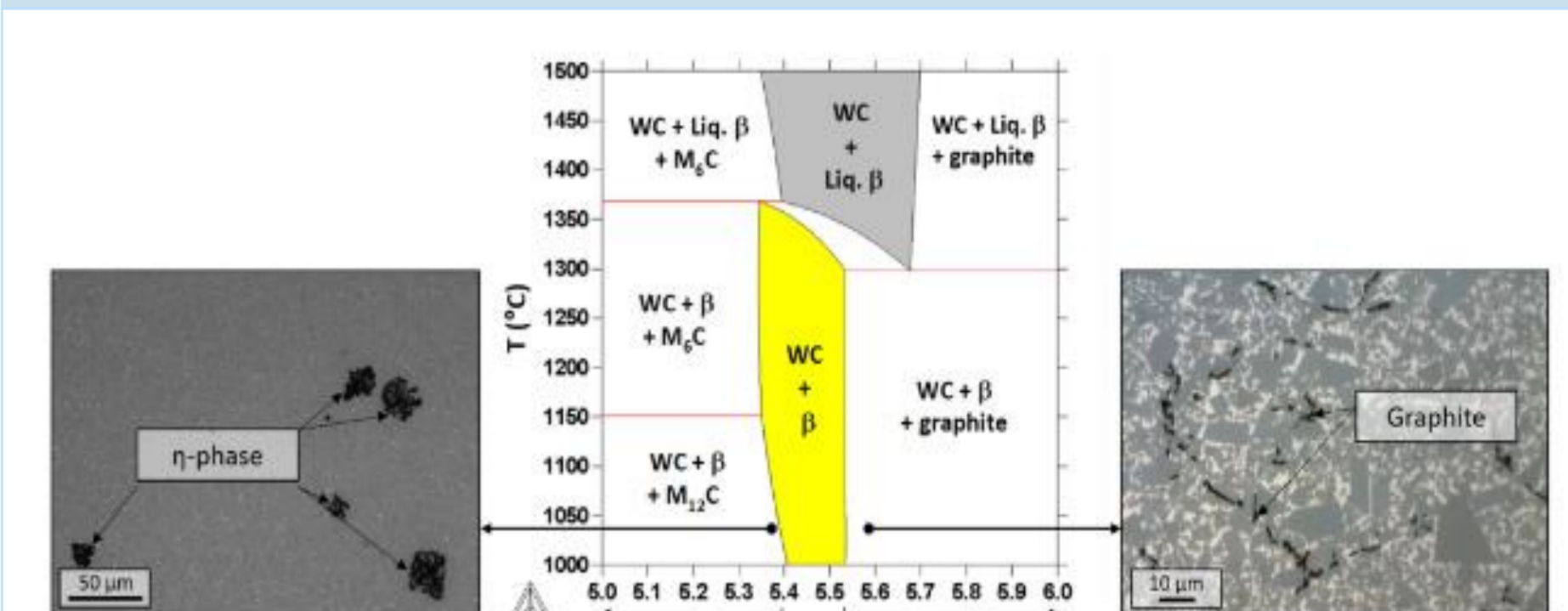
- Time/energy saving
- Powder recycling
- Complex form
- Near net shape

**Problems to solve**

- Which powder to use ?
- How to print ?
- Debinding/sintering cycle
- Shrinkage modeling ?



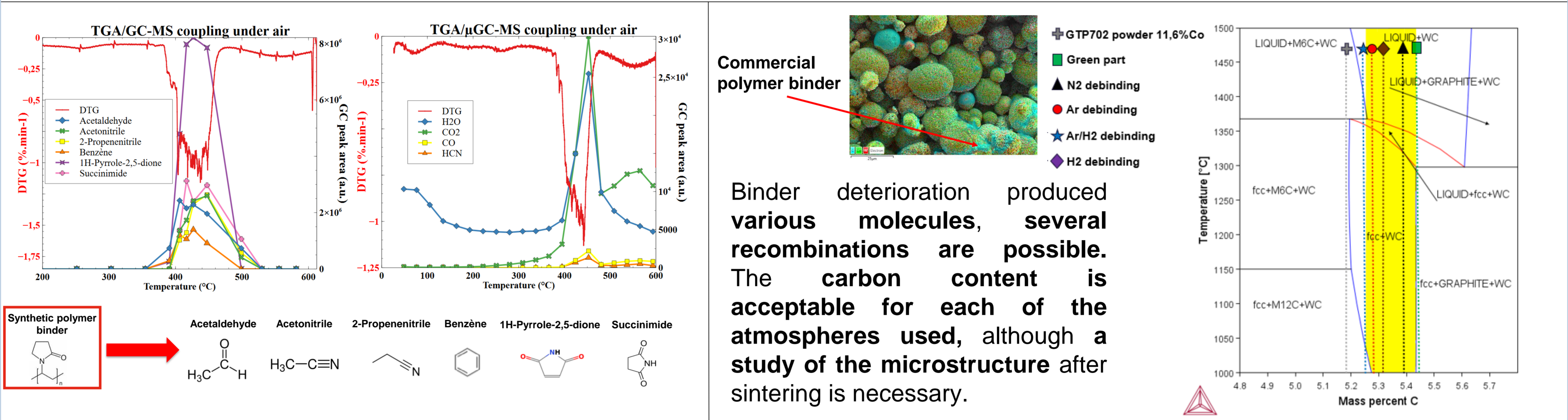
### Control of final properties



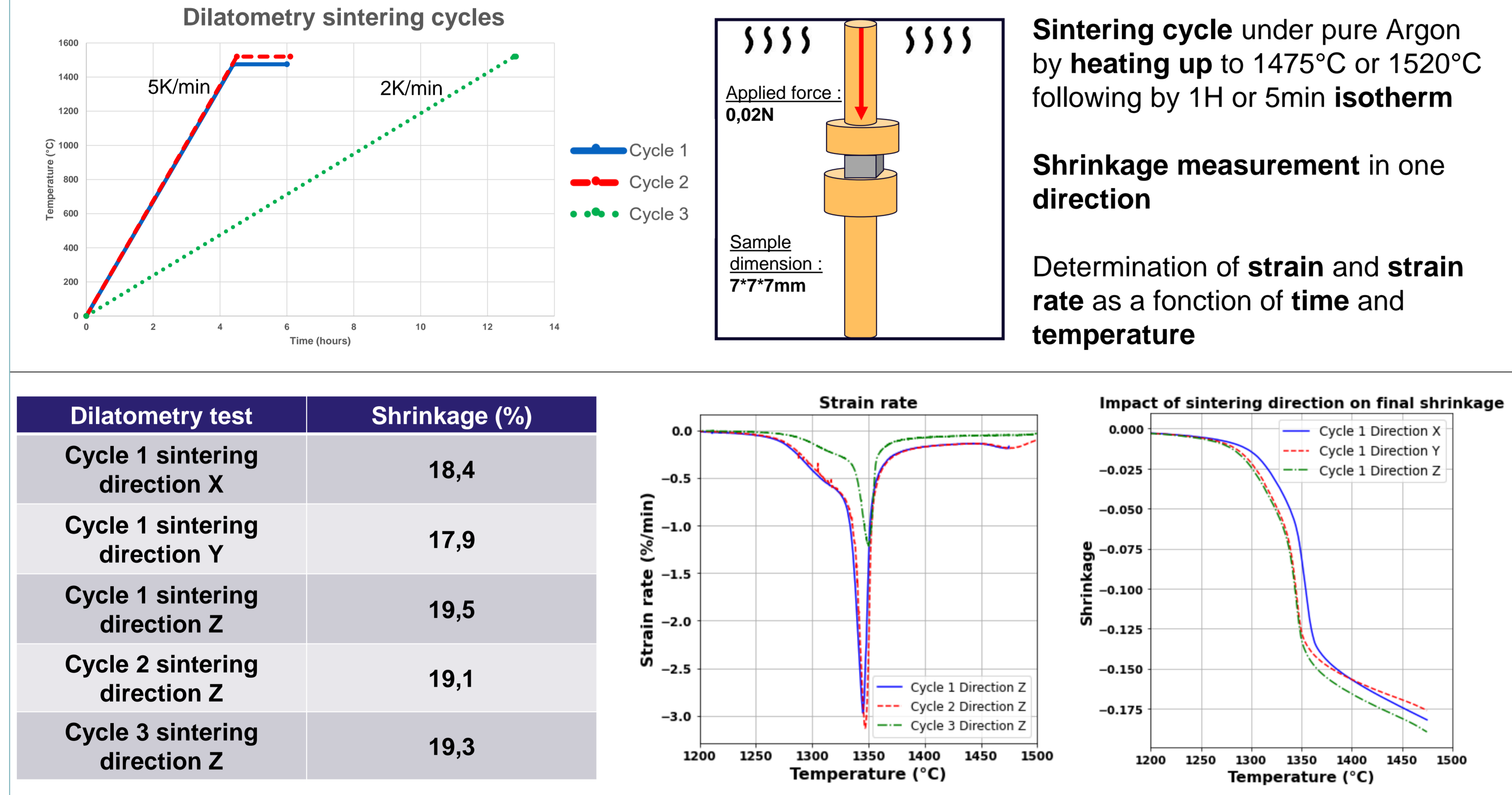
Good balance between **hardness** and **toughness**  
 High **transverse rupture strength (TRS)**  
**Carbon content window**  
**Density and grain size control**

## Debinding study by mass spectroscopy and carbon analysis

The aim of this study is to gain a better understanding of **binder deterioration during debinding**, and to **optimize the debinding cycle**. The objective is to **establish a link between carbon content and the debinding cycle**. Carbon content should be within the **carbon window** in order to maintain good **mechanical properties** : hardness, toughness, transverse rupture strength (TRS).



## Dilatometry with the Netzsch TMA 402 F1 Hyperion



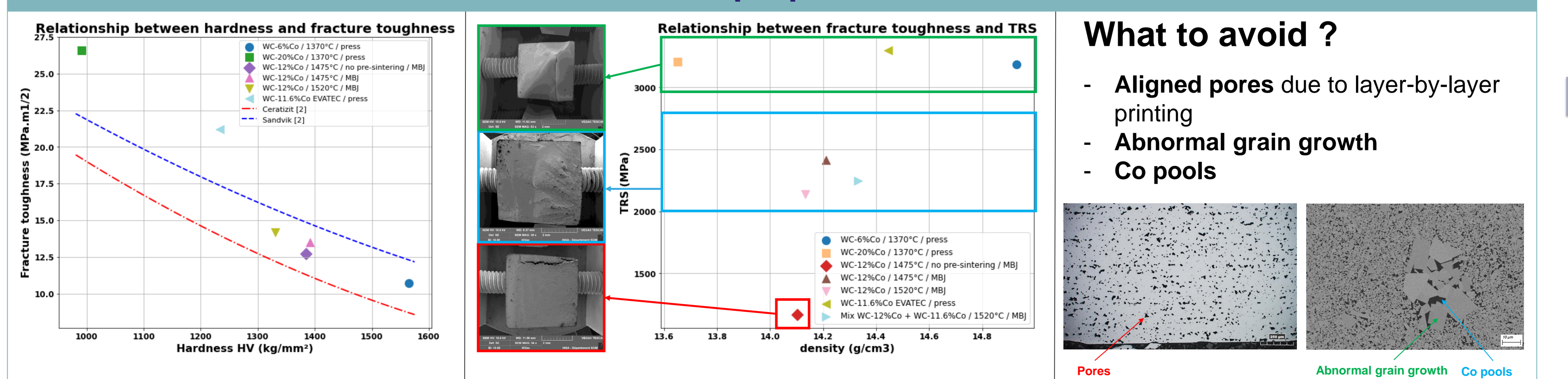
## Conclusions

- All debinding cycles are acceptable although study of impact on final properties is needed
- Final properties of binder jetted part can match the one from the press/sinter process
- Sintering anisotropy was quantified to be implemented in the shrinkage model

## Perspectives

- Impact of printing parameters on the green part strength and the final properties
- Predict the shrinkage during sintering using dilatometry data

## Final properties



[1] J. García, V. Collado Ciprés, A. Blomqvist, et B. Kaplan, « Cemented carbide microstructures: a review », *International Journal of Refractory Metals and Hard Materials*, vol. 80, p. 40-68, avr. 2019, doi: 10.1016/j.ijrmhm.2018.12.004.  
 [2] A. Chychko, J. García, V. Collado Ciprés, E. Holmström, et A. Blomqvist, « HV-KIC property charts of cemented carbides: A comprehensive data collection », *International Journal of Refractory Metals and Hard Materials*, vol. 103, p. 105763, févr. 2022