cbecimat26
26° Congresso Brasileiro de Engenharia e Ciência dos Materiais
November 22–26 2026
Costão do Santinho Florianópolis-SC
univap UNIVERSIDADE DO VALE DO PARAÍBA

Non-aqueous processing of Fe–C–Nb powders for extrusion-based additive manufacturing

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Introduction

- NbC-Fe is an alternative to WC-Co.
- Commercially available feedstock has agglomerates and coarse particles that hinder processing.
- Oxidation occurs in the aqueous route.

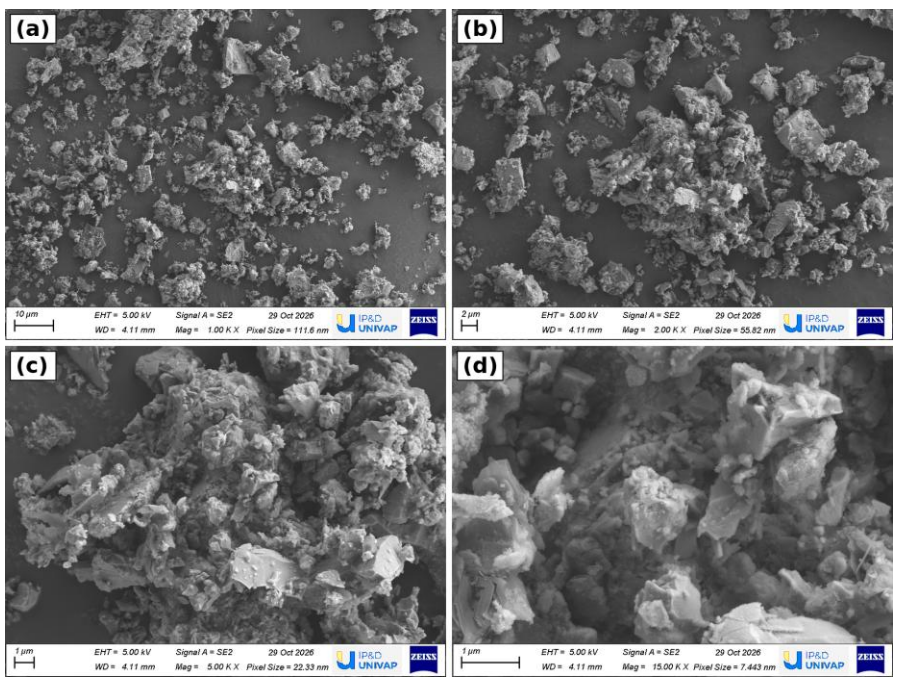
Objective

Develop a non-aqueous route to prepare extrudable NbC-Fe pastes for 3D printing (robocasting).

Methods

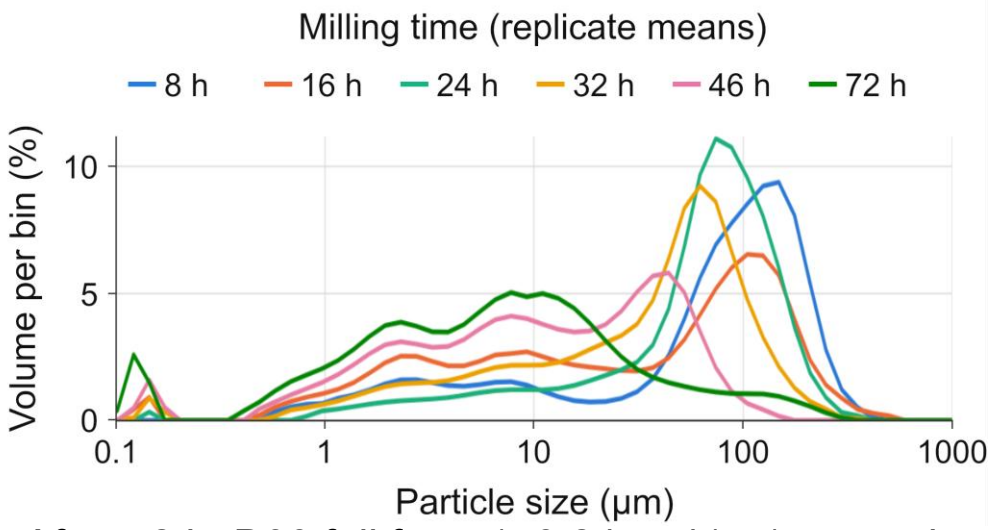
- Milling in isopropyl alcohol (IPA) / 72 h
- Dispersant: Hypermer B246SF.
- Powder particle size analysis and SEM.
- Rheometry of PVB solutions.
- Pastes with 10 wt% PVB B60H in IPA and PEG 1500.
- Printing with DuraPrinter, 2.5 mm nozzle.

Parameter	Sample 1	Sample 2
Powder milling	24 h	72 h
Powder (total wt%)	85.84	85.23
PVB/powder (wt%)	1.50	1.67
PEG/PVB (w/w)	1.00	0.40
Layers	Collapsed	Retained

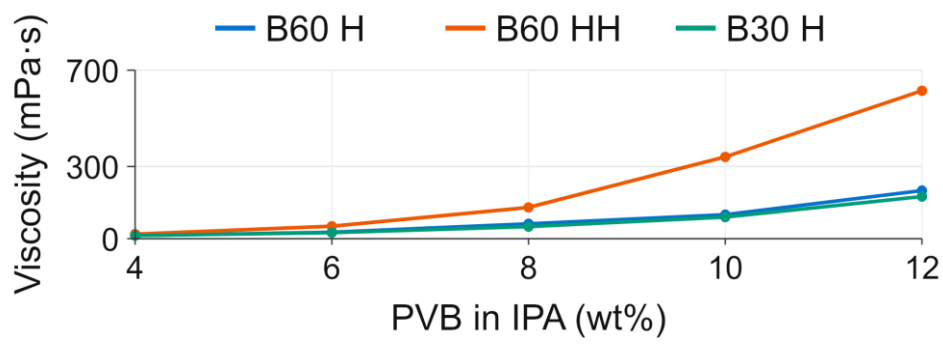


Powder after 72 h of milling: angular particles, adhering fines and remaining agglomerates.

Results and discussion



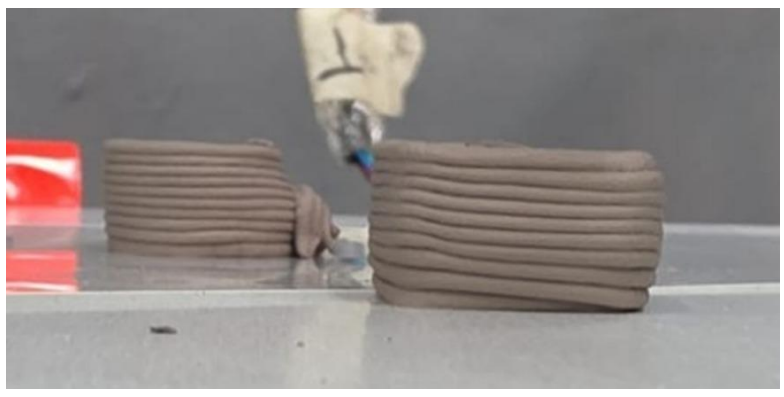
After 72 h, D90 fell from 173.24 to 41.51 µm and D50 reached 6.15 µm. The distribution remained broad.



Printing and layer stability



Left: sample 1, showing collapse.
Right: sample 2, retaining its shape.



Layers in the sample 2 printing trial.

Conclusions

The IPA/PVB/PEG route enabled stable deposition in one trial. Milling and additives improved performance. Repeatability, alumina contamination and sintering need assessment.

References

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Acknowledgments

BRATS FILTROS SINTERIZADOS PÓS METÁLICOS ESPECIAIS
FAPESP FUNDAÇÃO DE AMPARO À PESQUISA DO ESTADO DE SÃO PAULO
Grant Nos.: 2019/08927-2, 2022/06201-7
CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico
Grant Nos.: 441780/2024-5, 350440/2025-5, 350485/2025-9.