cbecimat26
26° Congresso Brasileiro de Engenharia e Ciência dos Materiais
22 a 26 de novembro de 2026
Costão do Santinho
Florianópolis-SC

Rheology-driven gelcasting of AISI 310 stainless steel composites reinforced with alumina and graphene: Effects on densification and microstructure



L. F. R. Oliveira[1]*, F. S. Ortega[2], R. Magnabosco[3], M. D. M. das Neves[1]
[1]Instituto de Pesquisas Energéticas e Nucleares, IPEN-CNEN/SP. [2]Universidade do Vale do Paraíba, Univap/IP&D. [3]Departamento de pós-graduação em Engenharia Mecânica, Centro Universitário da FEI.
*louisefernandarodrigues@gmail.com

INTRODUCTION AND OBJECTIVES

Demand for more effective and innovative materials and manufacturing processes → with good cost/benefit ratio

Academy x indústry

Composite Materials

Properties combination

X

Specificity of material application

- **AISI 310 Stainless Steel matrix composites reinforced by alumina and graphene nanoplateletes (GNP) using gelcasting process**
- **Linking rheology, densification and microstructure**

METHODS AND MATERIALS

❖Suspension rheology behavior:

- PVAl in a 50 v.% AISI 310 suspension (2, 4, 6, 8 and 10 wt.% of PVAl);
- Sodium polyacrylate (NaPA) in a 40 v.% alumina suspension (0.02, 0.04, 0.06, 0.08 and 0.10 wt.% of Acumer4800);
- Liquid medium: Water + monomers.

1 SUSPENSION	2 GELCASTING	3 DRYING	4 SINTERING
Powders + water MAM / PEG-DMA	Dispersion and molding APS + TMED	PEG 8000: 2 h 110 °C: 4 h	1280 °C: 1 h 8,5 °C/min

8 compositions: Al_2O_3 = 0, 1, 3 or 5% vol. × GNP = 0 or 0,5% vol.

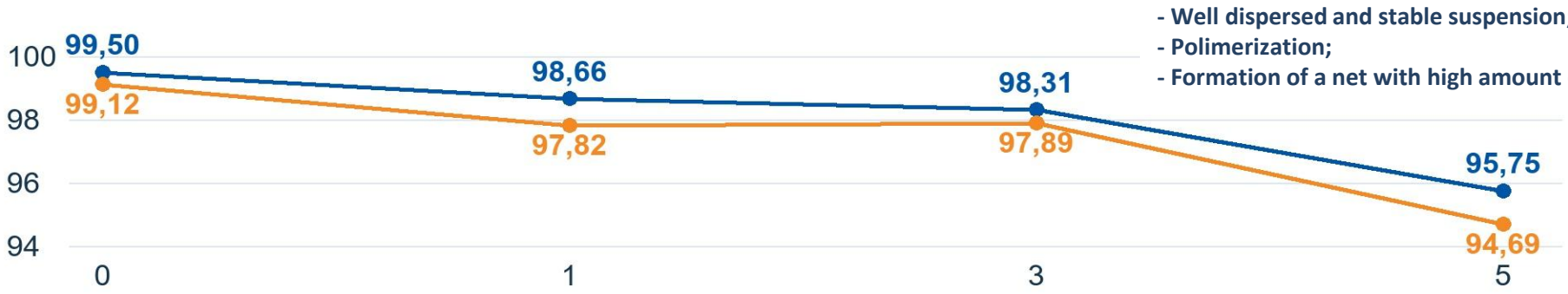
RESULTS AND DISCUSSION

- AISI 310: Higher density than alumina particles, resulting in a higher probability of settling;
- Alumina: Lower density than AISI 310 particles, with a higher tendency to agglomerate.

PVAl
Higher viscosity
Lower settling

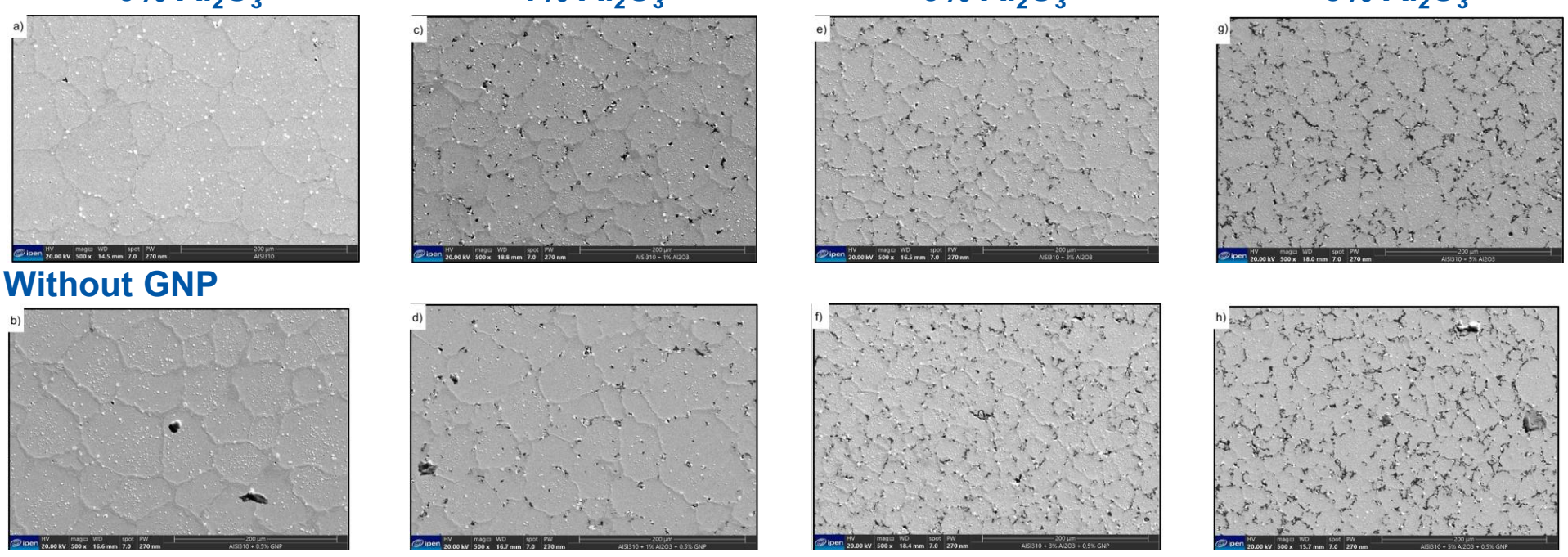
NaPA
Lower interaction between particles
Better dispersion

Relative density (%)



❖ Key of the process:
- Well dispersed and stable suspension;
- Polimerization;
- Formation of a net with high amount of cross-links.

0% Al_2O_3 | **1% Al_2O_3** | **3% Al_2O_3** | **5% Al_2O_3**



CONCLUSIONS

PVAl and NaPA play complementary roles in the processing.

Relative density: 94.69–99.50%, with a reduction in formulations containing 5 vol.% Al_2O_3.

REFERENCES

OLIVEIRA, L. F. R.. Caracterização de compósitos de matriz de aço inoxidável AISI 310 reforçado com partículas de alumina e grafeno processado por gelcasting. 2024. Tese (Doutorado) – Universidade de São Paulo, São Paulo, 2024. Disponível em: https://teses.usp.br/teses/disponiveis/85/85134/tde-20092024-113707/. Acesso em: 15 nov. 2026.

WIECINSKA, P.; SKRZOS, L.; PROKURAT, N. New route for processing of multilayer Al2O3-Co3O4 materials through gelcasting. Journal of the European Ceramic Society, v. 37, n. 4, p. 1627-1634, dez. 2016. Disponível em: . Acesso em: 10 jan. 2017.

TABANDEH-KHORSHID, M.; FERGUSON, J. B.; SCHULTZ, B. F.; KIM, C. S.; CHO, K.; ROHATGI, P. K. Strengthening mechanisms of graphene- and Al2O3 reinforced nanocomposites synthesized by room temperature milling, Materials and Design, v. 92, p.79-87, 15 fev. 2016. Disponível em: . Acesso em: 14 março 2020.

AKNOWLEDGEMENTS