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Synthesis of nanostructured Ni-P hollow microspheres for the fabrication of porous materials via powder metallurgy

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Introduction

Metallic foams offer low density and tailored properties (Banhart, 2001). For that, hollow sphere powders yield uniform architectures without space holders (Öchsner & Fiedler, 2009). Here, nanostructured Ni-P spheres were synthesized via SDS-vesicle-templated electroless plating (Bernardi et al., 2007), then compacted and sintered at temperatures up to 750 °C, resulting in approximately 50% porosity, to evaluate their consolidation behavior and properties.

Objectives

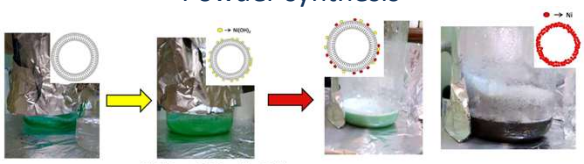
To evaluate the viability of nanostructured hollow Ni-P spheres as raw materials for sintered porous metallic structures.

Specific Objectives

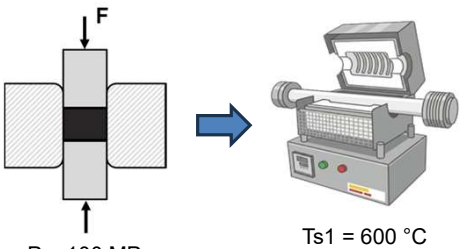
- Synthesize hollow Ni-P spheres via electroless deposition using SDS vesicle structures.
- Consolidate the material into porous samples through uniaxial pressing and sintering.
- Characterize the sintered material to validate the porous structure and to evaluate the effect of sintering temperature.

Methodology

Powder synthesis



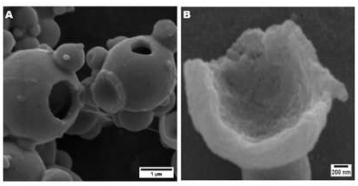
Pressing and sintering



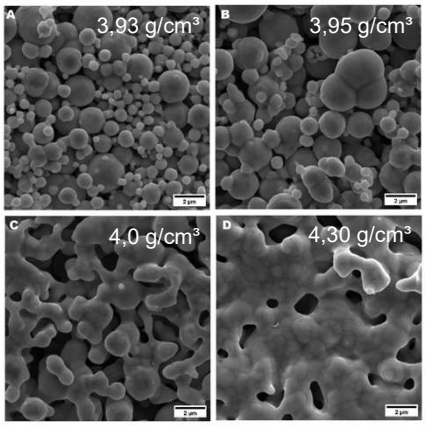
P = 100 MPa
D = 9,9 mm
Cylindric die

Ts1 = 600 °C
Ts2 = 650 °C
Ts3 = 700 °C
Ts4 = 750 °C

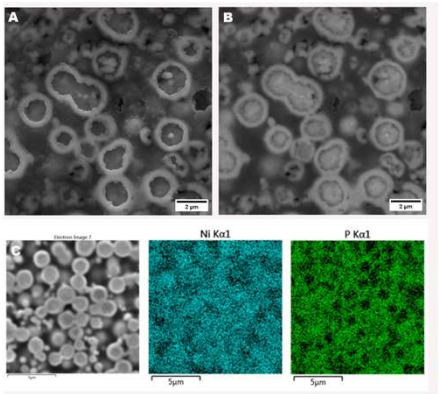
Results



Ni-P particles etched with a HNO3 solution. (A) Hollow spheres and (B) nanostructures.



Samples sintered at (A) 600 °C, (B) 650 °C, (C) 700 °C and (D) 750 °C.



Metallography of a sintered sample. (A) SE, (B) BSE, (C) EDS.

Conclusions

- Ni-P hollow spheres where synthetised using SDS vesicle structures.
- It was possible to fabricate foam like materials through pressing and sintering.
- Further studies must investigate if the unetched microspheres are hollow.

References

J. Banhart, PII: S0079-6425(00)00002-5 (2001); Öchsner & Fiedler, e-ISBN 978-3-642-00491-9 (2009); Bernardi et al, DOI 10.1007/s10853-007-1829-x (2007)