

Preparation and mechanical properties of titanium-nickel shape memory alloy foams

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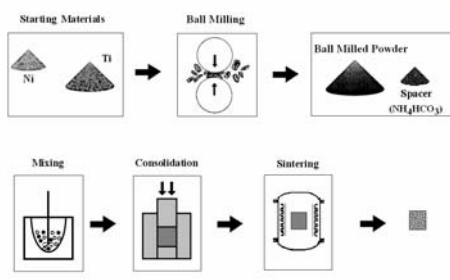
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1. Introduction

- There has been extensive recent interest in the production and mechanical properties of lightweight metallic foams
- Space-holder sintering is an efficient method to control the porosity of metallic foam
- Titanium-nickel (TiNi) shape memory alloy (SMA) foams may be used to create light-weight, reusable energy absorbing materials, biomaterials, or highly damage-tolerant “self-repairing” materials.

2. Experimental

2.1. Preparation of TiNi alloy foam



2.2. Compression test

MTS 100 KN

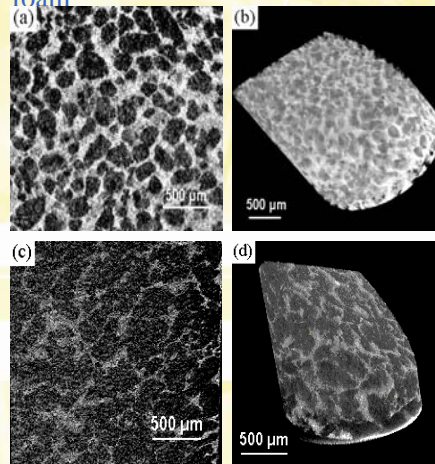
Room temperature

Load rate: $1 \times 10^{-4} \text{ s}^{-1}$



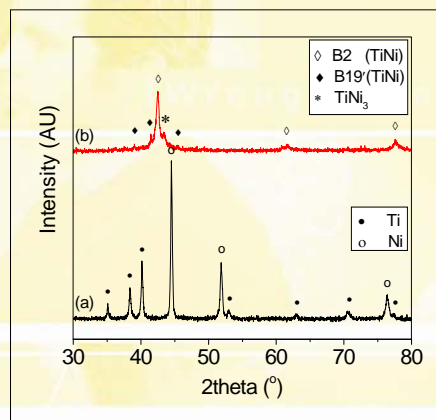
3. Results and discussion

3.1. The porous structure of TiNi foam

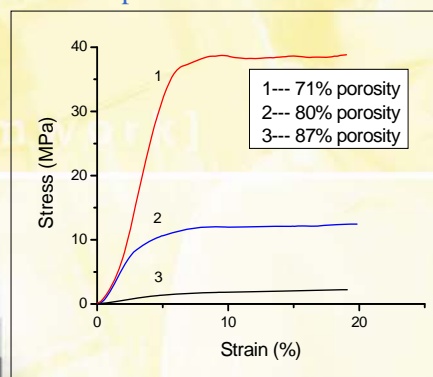


X-ray microtomography images of TiNi alloy foams with different porosities: (a) (b) 71% porosity; (c) (d) 80% porosity.

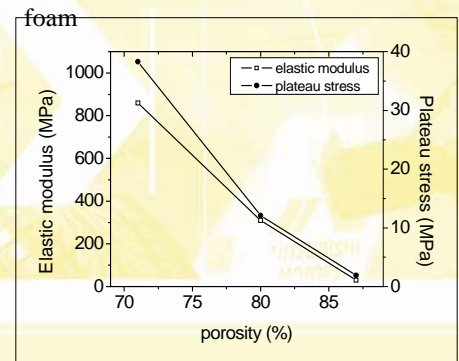
3.2. XRD patterns of (a) Ti-Ni powder after 2 h ball milling and (b) the sintered TiNi alloy foam



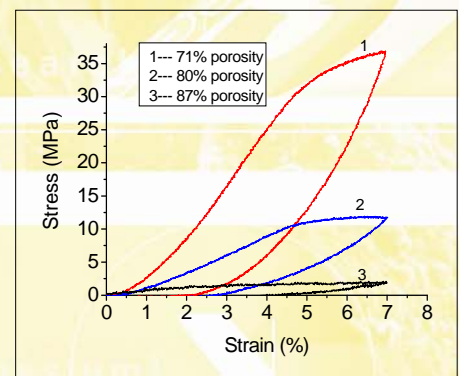
3.3. Compressive stress-strain curves of TiNi alloy foams with different porosities



Relationship between mechanical properties and porosity of TiNi alloy foam



3.4. Loading-unloading compressive tests of TiNi alloy foams with different porosities



Shape memory effect of TiNi alloy foam

Porosity (%)	Residual strain (%)	Recovered strain (%)*
71	2.2	1.53
80	2.8	1.15
87	4.5	0.90

* After heating to 200 °C and the cooling

4. Conclusions

- The elastic moduli and plateau stresses of the TiNi foams decrease with the increase of porosity.
- The TiNi foams exhibit shape memory effect. The recoverable strain due to shape memory effect decreases with the increase of foam porosity.
- Future work is needed to achieve higher recoverable strain for the shape memory alloy foams.

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