Influence of the Manufacturing Conditions on the Magnetic Behaviour of a $Fe_{50}Ni_{50}$ Alloy by Using Process Control Agents and Precursors with C and N

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INTRODUCTION

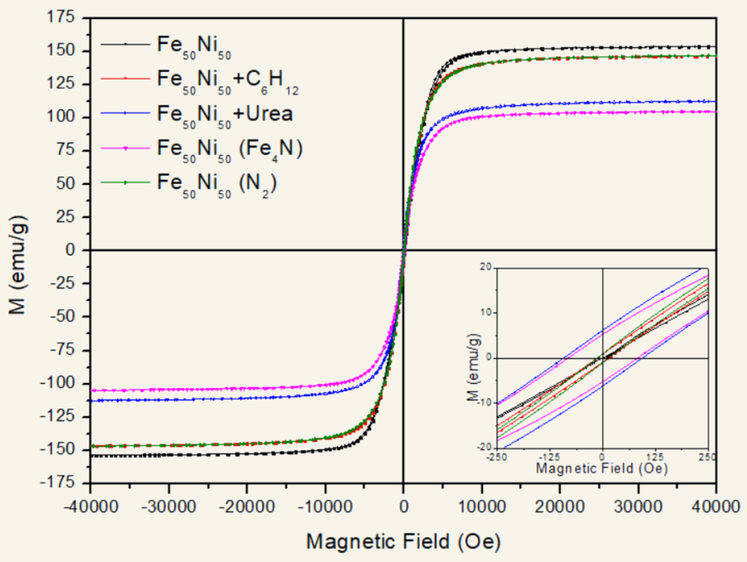
- The reduction of the carbon footprint of magnetic materials is vital and hard to achieve.
- This is minimised by using free rare-earth metals in the manufacturing of magnetic alloys.
- The $Fe_{50}Ni_{50}$ magnetic alloy with a tetragonal crystallographic structure ($L1_0$) is one of the strong candidates, however, it is not easily obtained.
- This study focuses on trying to obtain this $L1_0$ structure by means of positioning smaller elements (C and N) interstitially within the stable cubic matrix of the alloy at room temperature.

MATERIALS AND METHODS

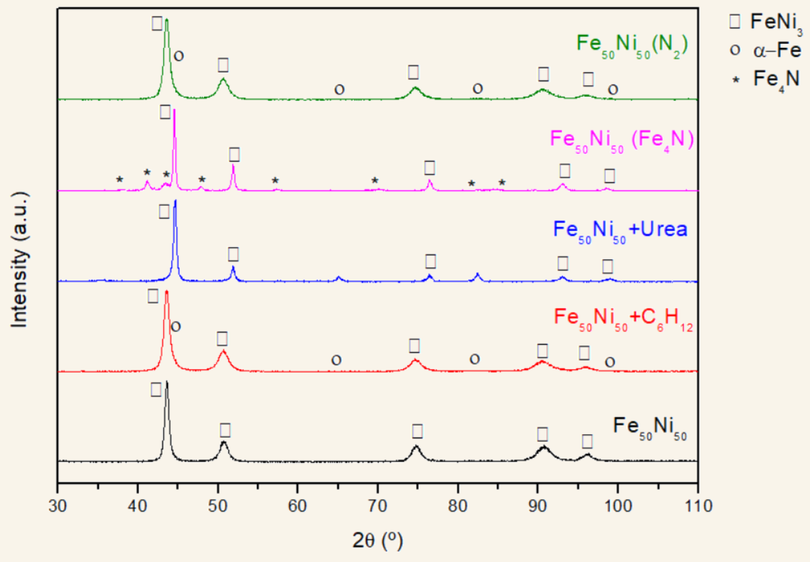
- Five $Fe_{50}Ni_{50}$ mechanical alloyed samples:
  - *S1: only elemental powders*
  - *S2: powders with 1 mL of C_6H_{12}*
  - *S3: powders with 1 g of urea and annealing (10 min at 473K)*
  - *S4: commercial Fe_4N as precursor*
  - *S5: powders with milling under N_2*
- Analyses performed:
  - *Vibrating Sample Magnetometer, VSM*
  - *X-Ray Diffraction, XRD*
  - *Differential Scanning Calorimetry, DSC*

RESULTS

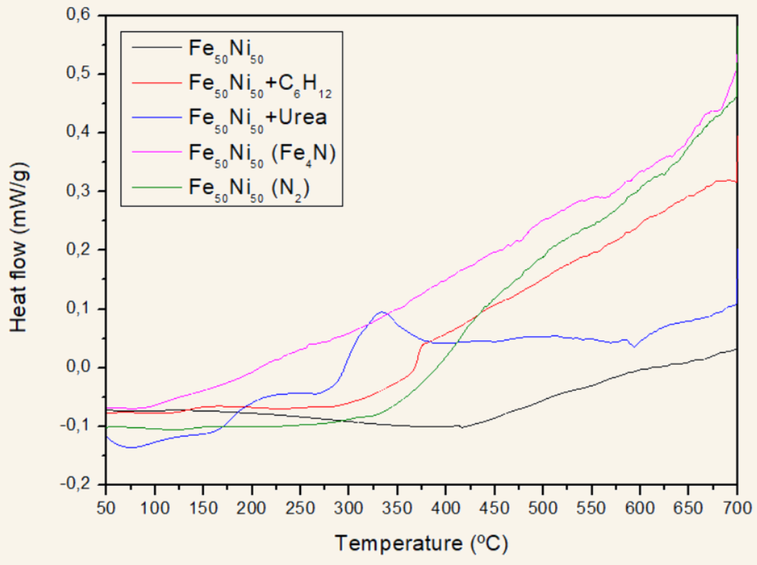
VSM



XRD



DSC



CONCLUSIONS

- Samples with urea and the commercial Fe_4N present a harder magnetic response.
- The sample with urea has higher values of coercivity and saturation magnetization.
- XRD analysis determines that the $FeNi_3$ phase (FCC) is the majoritarian structure in all samples.
- No notable differences between samples were observed by DSC.
- producing the $Fe_{50}Ni_{50}$ alloy using precursors with N alter the magnetic response of the alloy.
- The desired L10 structure is not obtained.

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