Hydrogen storage properties of TiFe + x wt.% ZrMn₂
(x = 2, 4, 8, 12) alloys by arc melting
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Abstract

We present the effects of ZrMn₂ on hydrogen storage properties of TiFe+x wt.%ZrMn₂ alloys prepared by arc melting. Each alloy is made of two phases: a primary phase with small amount of zirconium and manganese, and a secondary phase which has a higher proportion of zirconium and manganese. We found that when x increases, the first hydrogenation is much faster and the alloy is getting more stable. Moreover, for x = 12, air exposure had a minimal impact on hydrogen sorption behavior.

Introduction

TiFe alloy is a promising candidate for solid state hydrogen storage. However, the practical applications are limited due to the slow first hydrogenation, which needs high pressure and temperature[1]. In a previous investigation, we found that activation of TiFe alloy could be improved by adding Zr(2) and Mn(3).

Experiment

Alloys were prepared by arc melting. Morphology was measured by scanning electron microscopy. Structure was done by X-ray diffraction. Hydrogen storage properties were measured by Sieverts-type apparatus.

First hydrogenation

This figure shows that these samples have similar microstructure which includes bright and dark phases. Table 1 shows that the bright phase increase with x.

<table>
<thead>
<tr>
<th>Phase</th>
<th>x=2</th>
<th>x=4</th>
<th>x=8</th>
<th>x=12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bright (%)</td>
<td>18.2</td>
<td>21.3</td>
<td>38.2</td>
<td>47.6</td>
</tr>
<tr>
<td>Dark (%)</td>
<td>81.8</td>
<td>78.7</td>
<td>61.8</td>
<td>52.4</td>
</tr>
</tbody>
</table>

Fig.2-Backscatter micrographs of TiFe+x wt.%ZrMn₂ (x=2, 4, 8, 12) alloys prepared by arc melting

Morphology

Fig.3 shows that for all composition the dark phase has titanium, iron and manganese with a very small amount of zirconium. The bright phase is zirconium and manganese rich. Actually zirconium is mainly located in the bright phase and not in the dark phase.

Air exposure

These figures show that air exposure has no effect on the first hydrogenation but slightly reduce the maximum capacity. It also can be found that the absorption and desorption plateau pressure were similar for samples where expose to air or Ar. This means TiFe + 1/2 wt.%ZrMn₂ alloy is a good potential material to work in air.

Conclusion

1. The first hydrogen absorption capacity and kinetic of TiFe+x wt.%ZrMn₂ (x=2, 4, 8, 12) alloys increases with the amount of ZrMn₂.
2. All samples have similar microstructure which includes bright and dark phases, but the bright phase surface increases with the amount of ZrMn₂.
3. The air exposure has an small effect on the first hydrogenation of TiFe+12 wt.%ZrMn₂ alloy. But exposing to the air can result in decreasing the reversible capacity.

Reference


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