Effets des déformations mécaniques sur les propriétés d'absorption d'hydrogène des hydrures métalliques

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Solid state hydrogen storage in metal hydrides is a promising form of energy storage for stationary machines, backup power, and for heavy duty vehicles. In those applications, the system safety, low maintenance and operating costs or compactness far exceed the drawback of low gravimetric capacity. One important aspect of this form of storage is the potential of reversibility at room temperature which makes it particularly suitable for commercial and industrial applications. Among the different possible alloys, TiFe is one of the lower cost intermetallic compounds that operate near room temperature (RT) and under mild hydrogen pressure. One problem with this alloy is that the first hydrogenation, the co-called activation, is a slow process, needing high hydrogen pressure and high temperature. The aim of the present investigation was to optimize the activation behaviour of TiFe alloy. We noticed that the addition of a small fraction of Zr in the alloy greatly reduce the activation time. Two different procedures were experimented: co-melt, where the TiFe was melted, then re-melted with the addition of Zr, and single-melt, where Ti, Fe and Zr were melted in one single operation. For the co-melted sample, absorption was complete is less than three hours and without any pre-treatments. For the single-melt sample, absorption took much longer (seven hours) also without pre-treatment. The effect of air exposure on activation properties was investigated. We found that, upon air exposure, the samples had the same maximum capacity with a slightly longer incubation time, due to the presence of a dense surface oxide layer. These results were confirmed by electron microscopy, which revealed the presence of a rich Zr intergranular phase in the TiFe matrix.