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# Hydrogen absorption study of high-energy reactive ball milled Mg composites with palladium additives

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## Abstract

Hydrogenation behaviour, structure, morphology and dehydrogenation/re-hydrogenation performances of Mg–Pd nanocomposites prepared by high-energy reactive ball milling in $H_2$ (HRBM) of Mg in the presence of amorphous and crystalline Pd black (0.1–5 wt.%) were studied. Improvements of hydrogenation kinetics during HRBM were observed only for the materials prepared using crystalline Pd black. The obtained nanocomposites were characterised by modest improvements in their dehydrogenation and re-hydrogenation performances associated with the formation of Mg–Pd intermetallides.

## 1. Introduction

Over the last two decades, numerous studies were undertaken in an effort to enhance Mg hydrogenation rates [1]. One of the most promising approaches was found to be mechanical milling (MM). The products of MM often exhibit unusual physical and chemical properties and enhanced reactivity, in particular with respect to hydrogen. The enhancements are especially pronounced for Mg-based materials where nanostructuring and surface modification result in dramatic improvements in the hydrogenation kinetics [2]. Additional improvement of the hydrogenation performances of Mg was observed upon introduction of catalytic additives, including transition metals, alloys and intermetallic compounds [3–9]. High energy reactive ball milling (HRBM) of Mg with catalytic additives in $H_2$ has been proven to be the most efficient way to further improve the re-hydrogenation process [6,7].

The catalytic effect of the metallic additives, most probably, relates to facilitation of the reactions of hydrogen transfer, including dissociative chemisorption and associative desorption of $H_2$ molecules. One of the most efficient catalysts for these processes is palladium. Indeed, Pd-coated magnesium thin films were shown to be characterised by significantly improved kinetics of hydrogenation of Mg and dehydrogenation of the formed $MgH_2$ [10–12]. At the same time, HRBM of Mg with Pd additive was shown to inhibit both hydrogenation and re-hydrogenation of Mg [13].

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