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Magnesium Silicide and Germanide from Electronic Waste as a Source of CVD Precursors for Potential Catalysts Preparation

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The rapid development in electronics industry over the past few years has brought a wide range of new electronic devices to the market. This ever-growing worldwide trend in both manufacturing and electronic consumption also brings a lot of issues related to increasing raw materials mining, processing and especially recycling. Due to the massive production of electronics and their shorter lifespan, recycling is the key issue. Semiconducting elements such as silicon and germanium play an important role in a number of electronic devices. For this reason, this work is focused on the regeneration of silicon and germanium from electronic waste and on the possibility of intermediate products utilization e.g. for chemical vapour deposition (CVD) and catalysis.

The recycling process is based on low temperature synthesis of magnesium silicide (Mg_2Si), magnesium germanide (Mg_2Ge) or their mixtures directly from milled end-of-life photovoltaic cells and/or broken germanium lenses with waste magnesium chips. Prepared samples were then hydrolysed by phosphoric acid to produce the corresponding hydrides, silanes ($\text{Si}_n\text{H}_{2n+2}$), germanes ($\text{Ge}_n\text{H}_{2n+2}$) and even germysilanes ($\text{Si}_x\text{Ge}_y\text{H}_z$), which are relatively thermally instable to the point that they can be easily decomposed into ultrapure elements Si, Ge and hydrogen. Moreover, it is possible to use them as desirable CVD precursors for the preparation of thin semiconductive layers or for the synthesis of metal silicides and germanides which could find potential use in the field of catalysis, thermoelectricity, and electronics.

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