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The Catalytic Role of Vanadium in Mg Nanostructures for Hydrogen Storage

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Using a glancing angle (co-)deposition technique, ~ 4.6 at.% V has been coated on the surface of individual Mg nanoblades and doped into Mg nanostructures fabricated at different deposition angles. The hydrogen storage properties of the formed V-decorated and V-doped Mg nanostructures depend strongly on how the nanocatalyst V surrounded by the host Mg and the porosity of the Mg nanostructures.

The structures are characterized by SEM, electron diffraction, and high resolution TEM. A phenomenological model based on heterogeneous reaction is proposed to explain the difference in hydrogen desorption activation energies. This work highlights the fundamental understanding of hydrogen interacting with the Mg nanostructures with different distributed nanocatalysts.

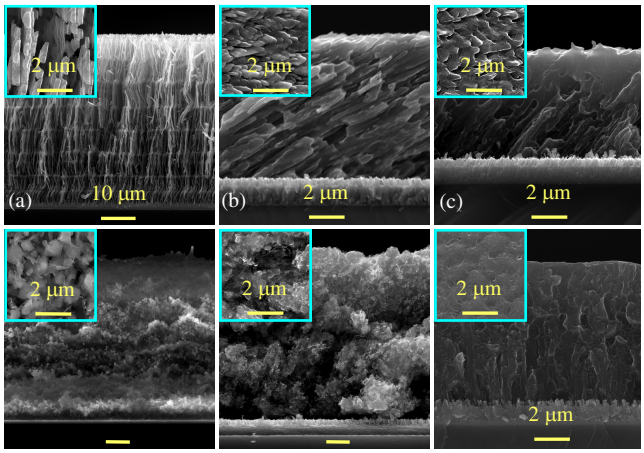

Figure 1. Cross-sectional SEM images for the as-deposited (a) S_{dec}^{70}, (b) S_{dop}^{70}, (c) S_{dop}^{50}, and (d) S_{dop}^{10}, the dehydrogenated (a′) S_{dec}^{70} after 14 cycles and (b′) S_{dop}^{70} after 21 cycles of hydrogen absorption and desorption, with the top view SEM images inserted in their top-left corner.

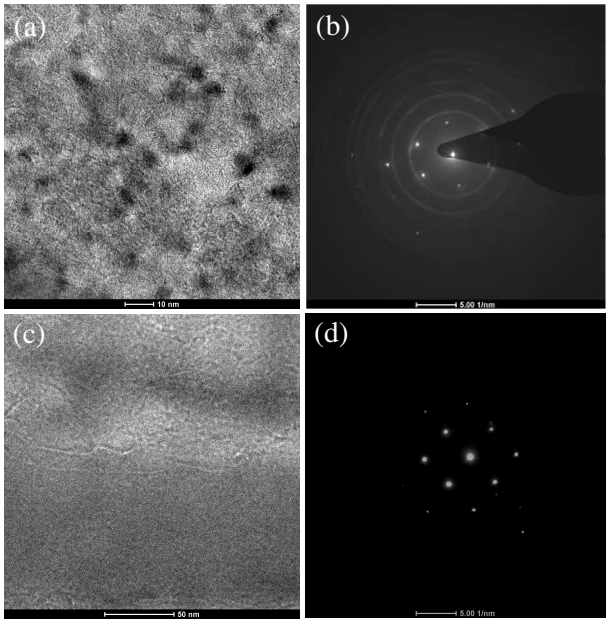

Figure 2. (a) TEM and (b) SAED of the as-deposited S_{dec}^{70} sample: the TEM image shows that the V exists in the form of randomly oriented crystals with an average diameter of $D = 5 \pm 1$ nm coated on the surface of the individual nanoblades; its SAED pattern is composed of the diffraction rings of V crystals and the diffraction spots of single crystal Mg. (c) TEM and (d) SAED of the as-deposited S_{dop}^{70} sample: there are no detectable V grains in the TEM image or diffraction signal in the SAED pattern, where only the Mg single crystal diffraction spots appear, indicating the V could exist in the form of atoms and/or very small clusters dispersed in the Mg matrix.

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