FULL-TEXT

Metal clusters: New era of hydrogen production

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Abstract

Clusters show intermediate properties between the isolated atoms and the bulk metals and represent the most elemental building blocks in nature (after atoms). They are characterized by their size, which establish a bridge between atomic and nanoparticle performances, with properties completely different from these two size regimes. If particle size becomes comparable to the Fermi wavelength of an electron, i.e. < 2 nm, then this is a cluster. Reducing the size from the bulk material to nanoparticles displays a scaling behavior in physical properties in the later ones, due to the large surface-to-volume portion. Through further size reduction, entering into the subnanometric cluster region, physical properties are largely affected by strong quantum confinement. These quantum size effects (HOMO-LUMO gap), the small size and the specific geometry grants subnanometric clusters with entirely novel properties, including cluster photoluminescence, enhanced catalytic activity, *etc*. In this literature review, an introduction to the physical properties of clusters is reported; the controlled synthesis methods and the catalytic properties in hydrogen evolution. Hydrogen (H_2) production by water splitting is hindered mainly by the lack of low-cost and efficient photocatalysts. Here, we show that sub-nanometric metal clusters can be used as photocatalysts for H_2 production in the presence of holes or electrons scavengers by water splitting. This illustrates the considerable potential of very small zerovalent, metallic clusters as novel atomic-level photocatalysts.

Keywords: Clusters, Nanomaterials, Photocatalysts, Hydrogen production, Water splitting.

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