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Au@PdO_x with PdO_x-rich shell and Au-rich core embedded in Co_3O_4 nanorods for catalytic oxidation of methane

Yan Zhu
Nanjing University, China

Methane is a potent greenhouse gas which contributes to more global atmosphere warming than CO_2 at equivalent emission rates. With significant attention paid to environment and health, the abatement of methane emissions from the engine exhaust is necessary. In order to develop novel catalyst with excellent catalytic performance, it is of paramount importance to improve catalytic activity of Pd-based but also to suppress the decline of Pd activity at the process of methane combustion. In this work, we design and prepare Au@PdO_x/Co_3O_4 catalyst, which is constructed with 4-8 nm Au@PdO_x and rod-like C_3O_4 domain. The packing structure of Au and Pd adopts a novel core-shell style and can be viewed as an Au-rich core encapsulated by an oxidized Pd shell consisting of PdO and PdO_2. When applied to the catalytic combustion of methane, Au@PdO_x/Co_3O_4 nanorods not only exhibit higher catalytic activity than Pd/Co_3O_4 and Au/Co_3O_4 nanorods, but also show higher resistibility to vapor water in the case of wet methane and stronger durability than Pd/Co_3O_4 nanorods. The excellent catalytic behavior of Au@PdO_0/Co_0O_4 nanorods is attributed to the strong interaction between Au@PdOx domain and Co_3O_4 domain, which facilitates adsorption and activation sites for the C-H bond in methane, as well as the specific structure between PdO_x-rich shell and Au-rich core, which ensure an effectual resistance to sintering and poison of the active species.

zhuyan@nju.edu.cn