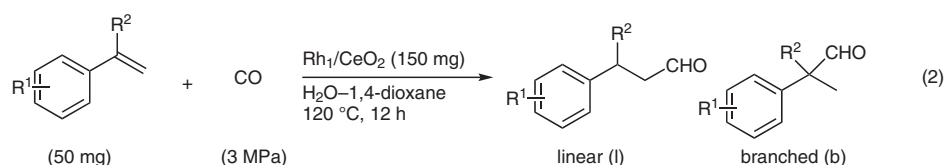
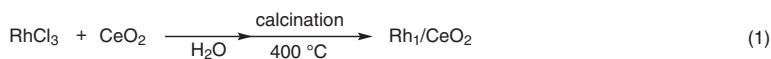


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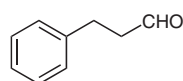
Styrene Hydroformylation with In Situ Hydrogen: Regioselectivity Control by Coupling with the Low-Temperature Water-Gas Shift Reaction

Angew. Chem. Int. Ed. 2020, 59, 7430–7434.

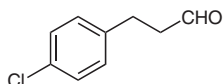
## Hydroformylation of Styrene Derivatives Catalyzed by Rhodium Single-Atoms Supported on CeO<sub>2</sub>



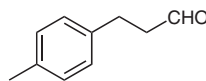
### Results:



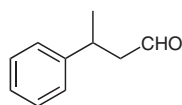
conversion: 55% yield  
selectivity for aldehyde: 75% yield  
l/b = 3.0



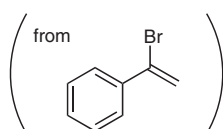
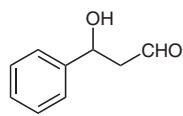
conversion: 94% yield  
selectivity for aldehyde: 61% yield  
l/b = 2.7



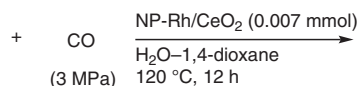
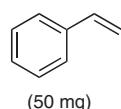
conversion: 49% yield  
selectivity for aldehyde: 72% yield  
l/b = 3.0



conversion: 47% yield  
selectivity for aldehyde: 80% yield  
l/b = 12



conversion: 99% yield  
selectivity for aldehyde: 77% yield  
l/b = 4.0



conversion: 97% yield  
selectivity for alcohol: 99% yield (3)

**Significance:** A rhodium single-atom catalyst on CeO<sub>2</sub> (Rh<sub>1</sub>/CeO<sub>2</sub>) was prepared by mixing RhCl<sub>3</sub> and CeO<sub>2</sub> in deionized water, followed by calcination at 400 °C (eq. 1). Rh<sub>1</sub>/CeO<sub>2</sub> catalyzed the hydroformylation of styrene derivatives with hydrogen generated in situ from water and carbon monoxide to give the corresponding linear aldehydes in ≤ 99% conversion (eq. 2).

**Comment:** Rh<sub>1</sub>/CeO<sub>2</sub> was characterized by means of ICP-OES, STEM, HAADF-STEM, FT-IR, EDS analyses. In the hydroformylation of styrene, Rh nanoparticles supported on CeO<sub>2</sub> (NP-Rh/CeO<sub>2</sub>) gave 3-phenylpropan-1-ol rather than 3-phenylpropanal, with 99% selectivity (eq. 3).

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Category

Polymer-Supported  
Synthesis

Key words

rhodium catalysis

hydroformylation

single-atom catalyst

styrenes

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