Controllable Synthesis of Ir(Rh)-Sn/SiO$_2$ Bimetallic Catalysts via Surface Organometallic Chemistry for the Production of Ethanol from Hydrogenolysis of Ethyl Acetate

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Figure S1. IR spectra of dehydroxylated SiO$_2$, Rh(COD)/SiO$_2$, Rh(COD)/SnBu$_3$/SiO$_2$ and Rh-Sn$_{1.00}$/SiO$_2$ obtained from the H$_2$ treatment of Rh(COD)/SnBu$_3$/SiO$_2$ at 400 °C.
**Figure S2.** $^{13}$C CP/MAS spectrum of monometallic surface compound Rh(COD)/SiO$_2$. 
Figure S3. $^{13}$C CP/MAS spectrum of bimetallic surface compound Rh(COD)/SnBu$_3$/SiO$_2$. 
Figure S4. XRD patterns of Rh-Sn/SiO\textsubscript{2} bimetallic catalysts with different Sn/Rh ratios.
Figure S5. STEM-EDS elemental mapping of Ir-Sn/SiO$_2$ bimetallic catalyst.
Figure S6. STEM-EDS elemental mapping of Rh-Sn/SiO$_2$ bimetallic catalyst.
**Figure S7.** SEM-EDS elemental mapping of Ir-Sn/SiO$_2$ bimetallic catalyst.
**Figure S8.** SEM-EDS elemental mapping of Rh-Sn/SiO$_2$ bimetallic catalyst.
Figure S9. Nitrogen adsorption isotherms of Ir-Sn/SiO₂ samples with different Sn/Ir ratios.
Figure S10. Nitrogen adsorption isotherms of Rh-Sn/SiO$_2$ samples with different Sn/Rh ratios.
Figure S11. XPS of Sn 3d core level of Rh-Sn/SiO$_2$ bimetallic catalysts with Sn/Rh ratios of 1, 2 and 3.
Figure S12. Infrared spectra of CO adsorbed on the Rh-Sn/SiO$_2$ bimetallic catalysts at room temperature.
Figure S13. Catalytic performance of Rh-Sn/SiO$_2$ catalysts for ethyl acetate hydrogenolysis reaction from 240 to 360 °C. Reaction conditions: pressure=5 MPa, H$_2$/ethyl acetate ratio=5 and WHSV=1.08 h$^{-1}$. 
Figure S14. Ethanol yield achieved in ethyl acetate hydrogenolysis over Ir-Sn/SiO$_2$ catalysts with different Sn/Ir ratios. Reaction conditions: pressure=5 MPa, H$_2$/ethyl acetate ratio=5 and WHSV=1.08 h$^{-1}$.
Figure S15. Ethanol yield achieved in ethyl acetate hydrogenolysis over Rh-Sn/SiO₂ catalysts with different Sn/Rh ratios. Reaction conditions: pressure=5 MPa, H₂/ethyl acetate ratio=5 and WHSV=1.08 h⁻¹.
Figure 16. Ethyl acetate conversion and ethanol selectivity over Rh-Sn$_{1.00}$/SiO$_2$ catalysts from grafting and impregnation synthesis. Reaction conditions: pressure=5 MPa, H$_2$/ethyl acetate ratio=5 and WHSV=1.08 h$^{-1}$. 
Figure S17. Ethanol yield achieved over Ir-Sn$_{1.00}$/SiO$_2$ catalysts from grafting and impregnation syntheses. Reaction conditions: pressure=5 MPa, H$_2$/ethyl acetate ratio=5 and WHSV=1.08 h$^{-1}$. 
Figure S18. Ethanol yield achieved over Rh-Sn\textsubscript{1.00}/SiO\textsubscript{2} catalysts from grafting and impregnation syntheses. Reaction conditions: pressure=5 MPa, H\textsubscript{2}/ethyl acetate ratio=5 and WHSV=1.08 h\textsuperscript{-1}.
Figure S19. The effect of H$_2$/ethyl acetate ratios on the catalytic performance of Rh-Sn$_{1.00}$/SiO$_2$ catalyst. Reaction conditions: temperature=300 °C, pressure=5 MPa and WHSV= 1.08 h$^{-1}$. 
**Figure S20.** The effect of reaction pressure on the catalytic performance of Rh-Sn$_{1.00}$/SiO$_2$ catalyst. Reaction conditions: temperature=300 °C, H$_2$/ethyl acetate ratio=10 and WHSV=1.08 h$^{-1}$. 
**Figure S21.** Product selectivity versus ethyl acetate conversion over Rh-Sn_{1.00}/SiO_{2} at 280 °C. Reaction conditions: pressure=5 MPa and H\textsubscript{2}/ethyl acetate ratio=10.
Figure S22. Stability of Rh-Sn$_{1.00}$/SiO$_2$ catalyst in ethyl acetate hydrogenolysis reaction. Reaction conditions: temperature=280 °C, pressure=5 MPa, H$_2$/ethyl acetate ratio=10 and WHSV=1.08 h$^{-1}$. 