

**Sulfur poisoning mechanism of steam reforming catalysts: an x-ray
absorption near edge structure (XANES) spectroscopic study**

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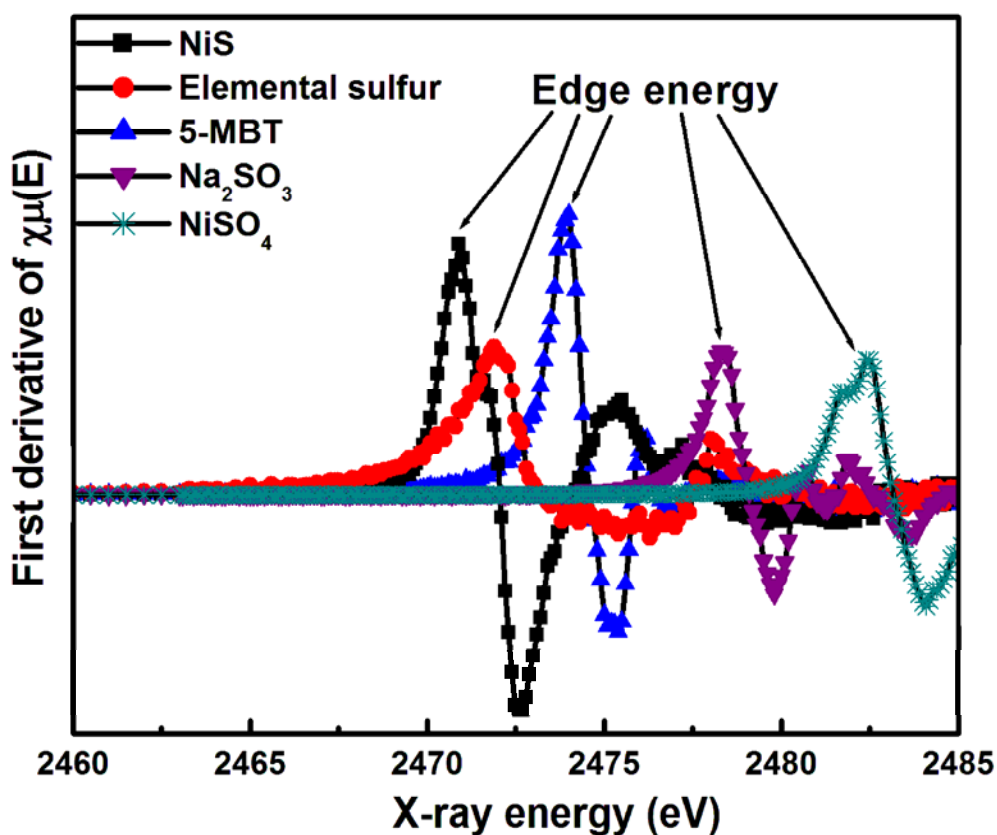
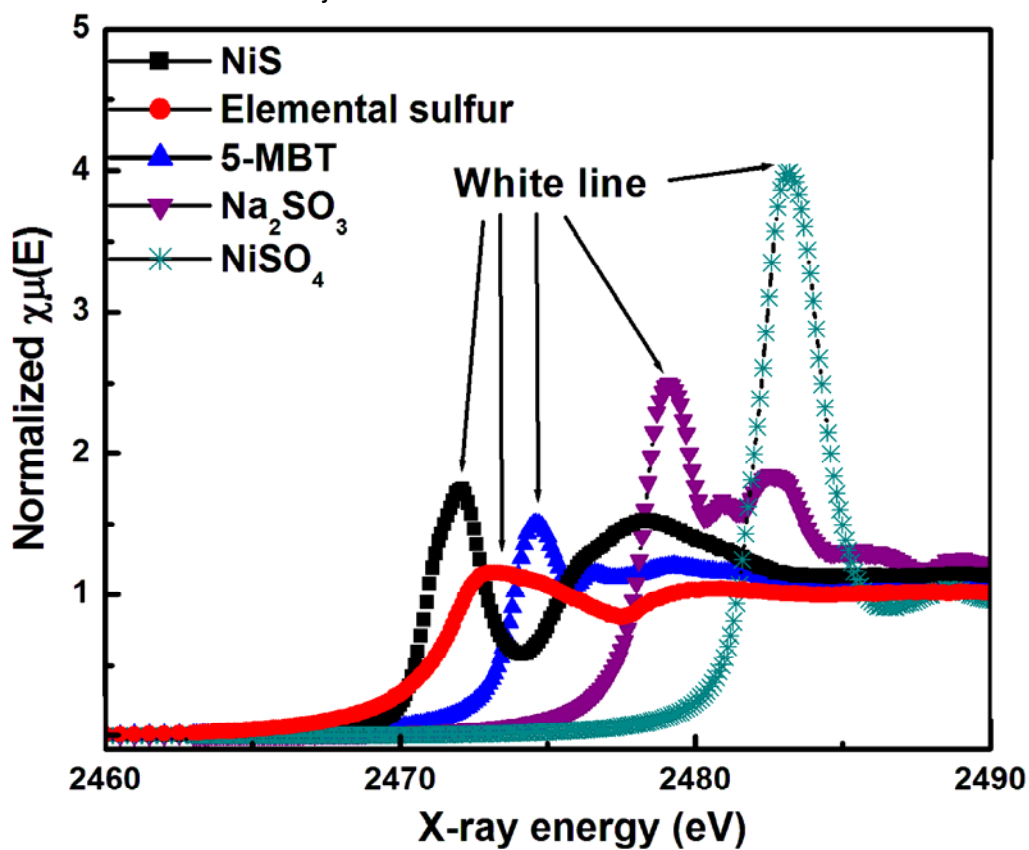


Figure S1. Sulfur standards. Top: absorption spectra (showing white line); Bottom: first derivative of the absorption spectra (showing edge energy).

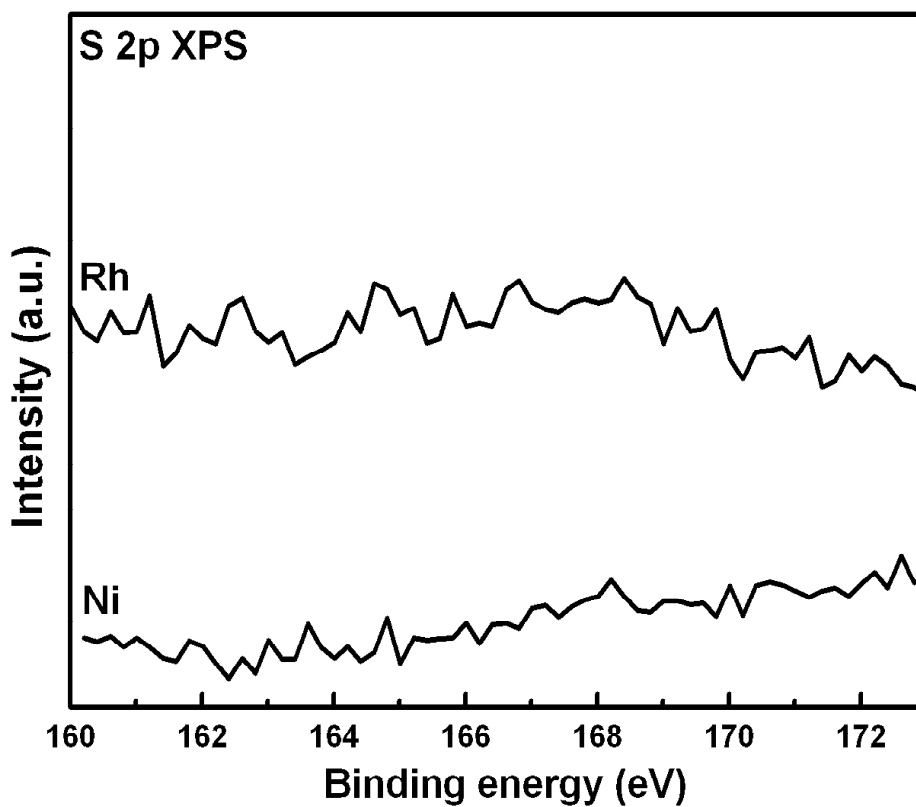


Figure S2 S 2p XPS of the used 2wt%Rh/CeO₂-Al₂O₃ and 10wt%Ni/CeO₂-Al₂O₃ after steam reforming reaction with sulfur at 800 °C for 55 h. Sulfur peaks would appear somewhere between 161-169 eV depending on their oxidation states and chemical environment.

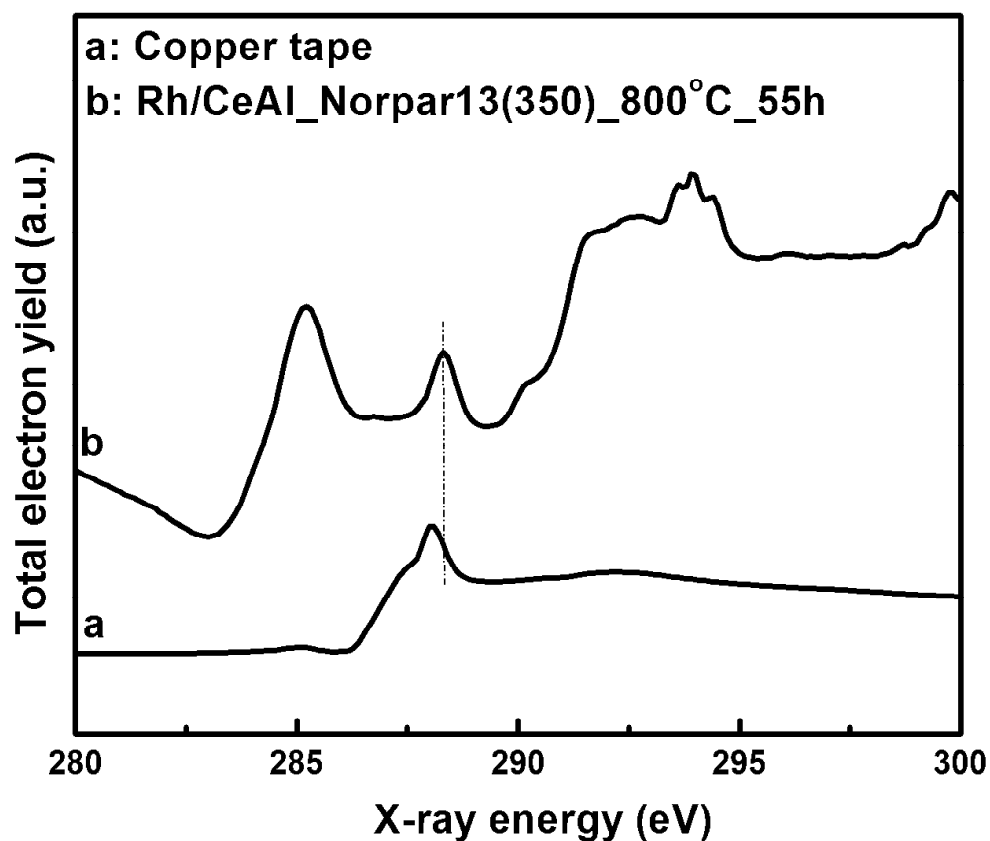


Figure S3. Carbon K-edge XANES spectrum of the copper tape used for sample preparation together with the spectrum of the Rh catalyst tested in the steam reforming reaction at 800 °C for 55 hours.

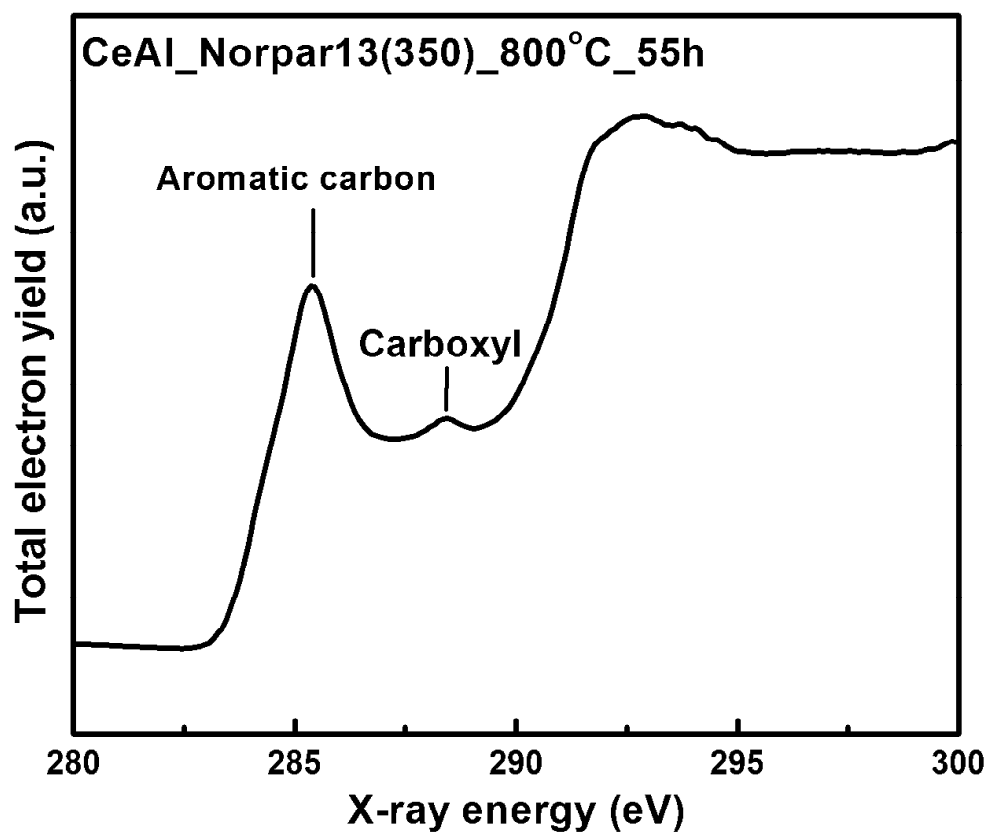


Figure S4. Carbon K-edge XANES spectrum of the used $\text{CeO}_2\text{-Al}_2\text{O}_3$ support after steam reforming of Norpar13 with 350 ppmw sulfur at 800 °C for 55 h. The reaction conditions are exactly the same as those used for testing of the Ni and Rh catalysts.

Table S1 Contents of metal sulfide, organic sulfide, and sulfate on the used 10wt%Ni/CeO₂-Al₂O₃ catalysts after steam reforming of Norpar13 with 350 ppmw sulfur at 800 °C for different reaction time

Reaction time (h)	Metal sulfide (M-S) mg/g'cat	Organic sulfide (C-S-C) mg/g'cat	Sulfate (SO ₄ ²⁻) mg/g'cat
5	0.85	0	0.05
15	0.69	0.07	0.17
30	0.22	0.44	0.20
55	0.54	0.22	0.20

Table S2 Molar ratio of S : C : Me (Me = Rh or Ni) for the used Rh and Ni catalysts after steam reforming of Norpar13 with 350 ppmw sulfur at 800 °C for 55 h

	S	C	Rh	Ni
2wt%Rh/CeO ₂ -Al ₂ O ₃	0.45	107.3	1	-----
10wt%Ni/CeO ₂ -Al ₂ O ₃	0.23	814.9	-----	1