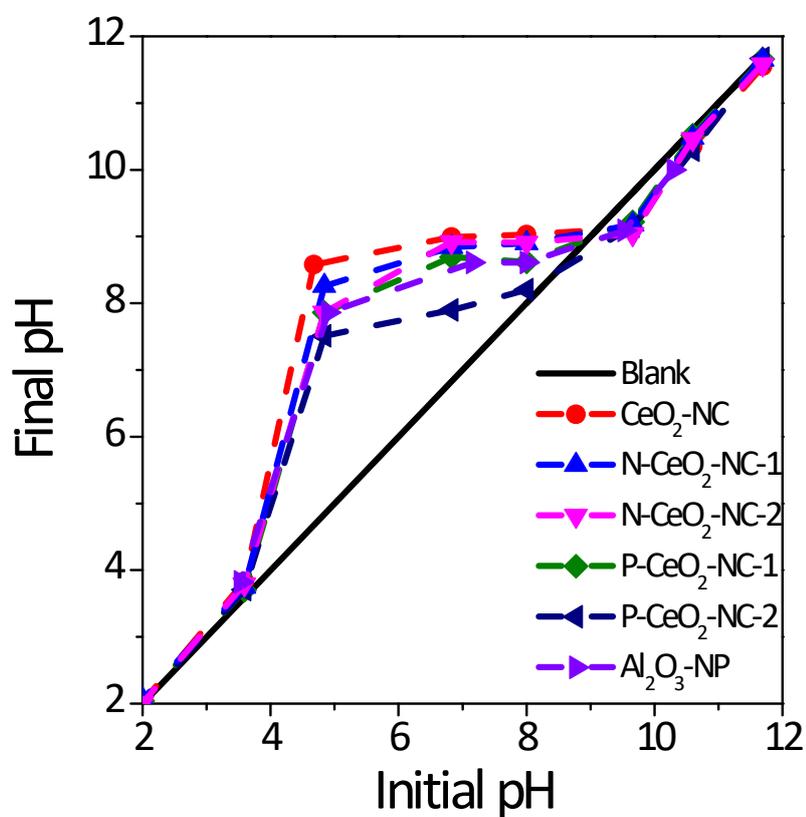
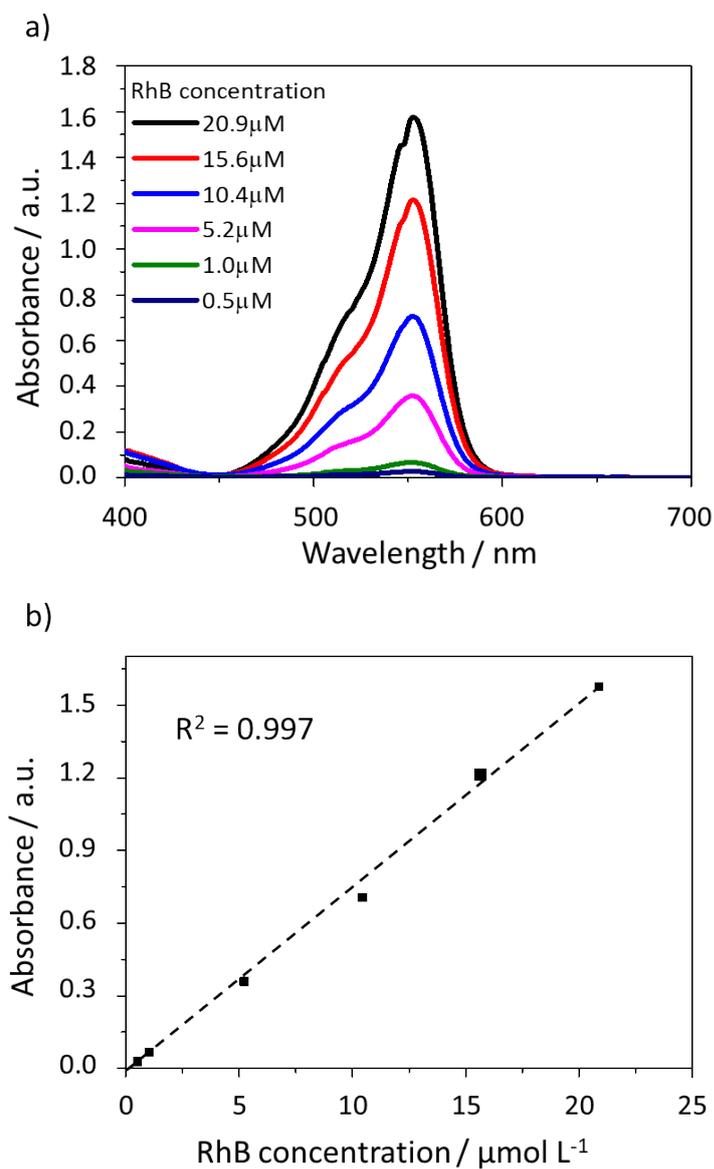


## Supplementary Information

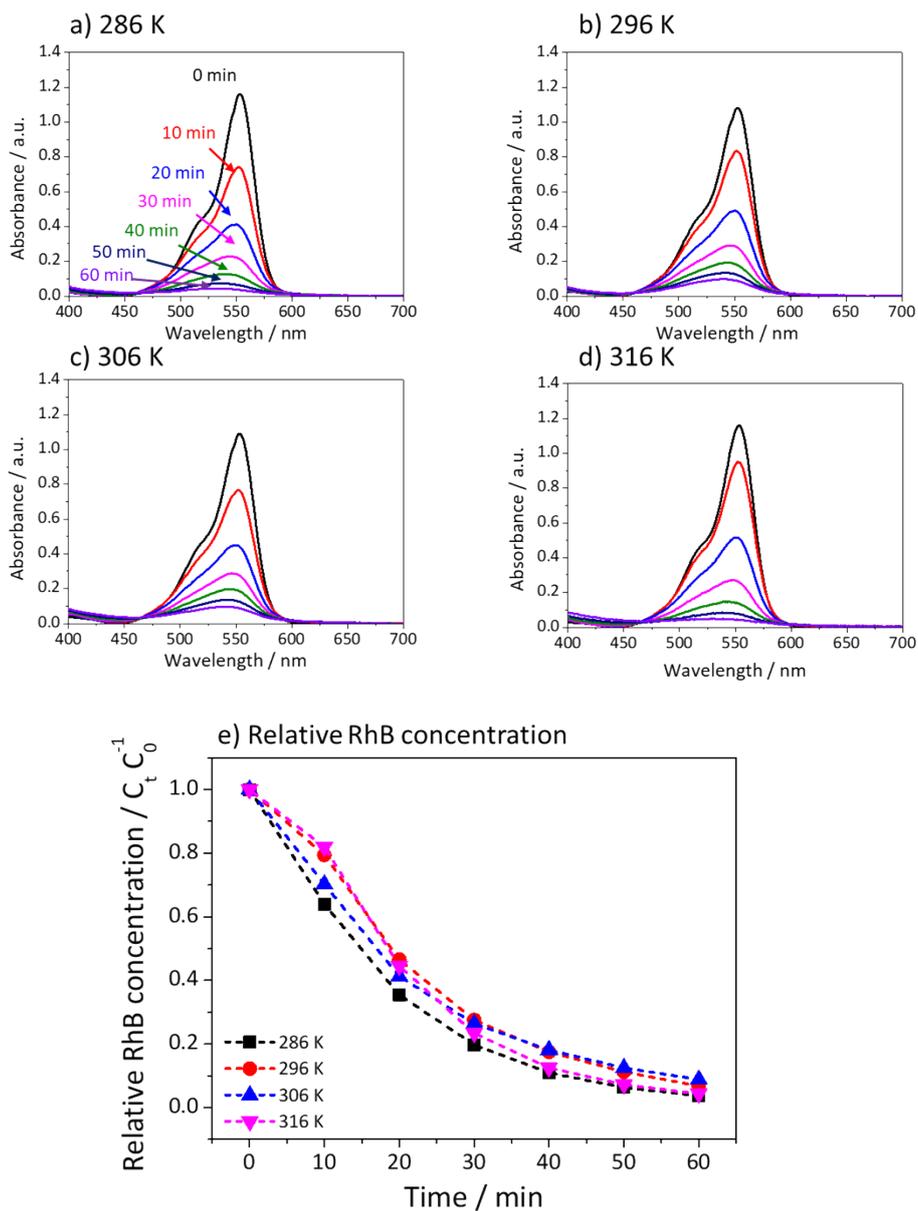
**Figure S1.** Measurement of the point of zero charge (PZC) for  $\text{CeO}_2\text{-NC}$ ,  $\text{N-CeO}_2\text{-NCs}$ ,  $\text{P-CeO}_2\text{-NCs}$ , and  $\text{Al}_2\text{O}_3\text{-NP}$  using the pH drift method. The PZC was determined by the intercept of the sample's pH drift curve with the blank line (where the initial and final pH values are equal).



**Figure S2.** a) UV-Vis spectra of aqueous RhB solutions at various concentrations, and b) a calibration curve demonstrating the linear relationship between RhB concentration (0.5 – 20.9  $\mu\text{M}$ ) and the absorbance peak intensity at 550 nm.

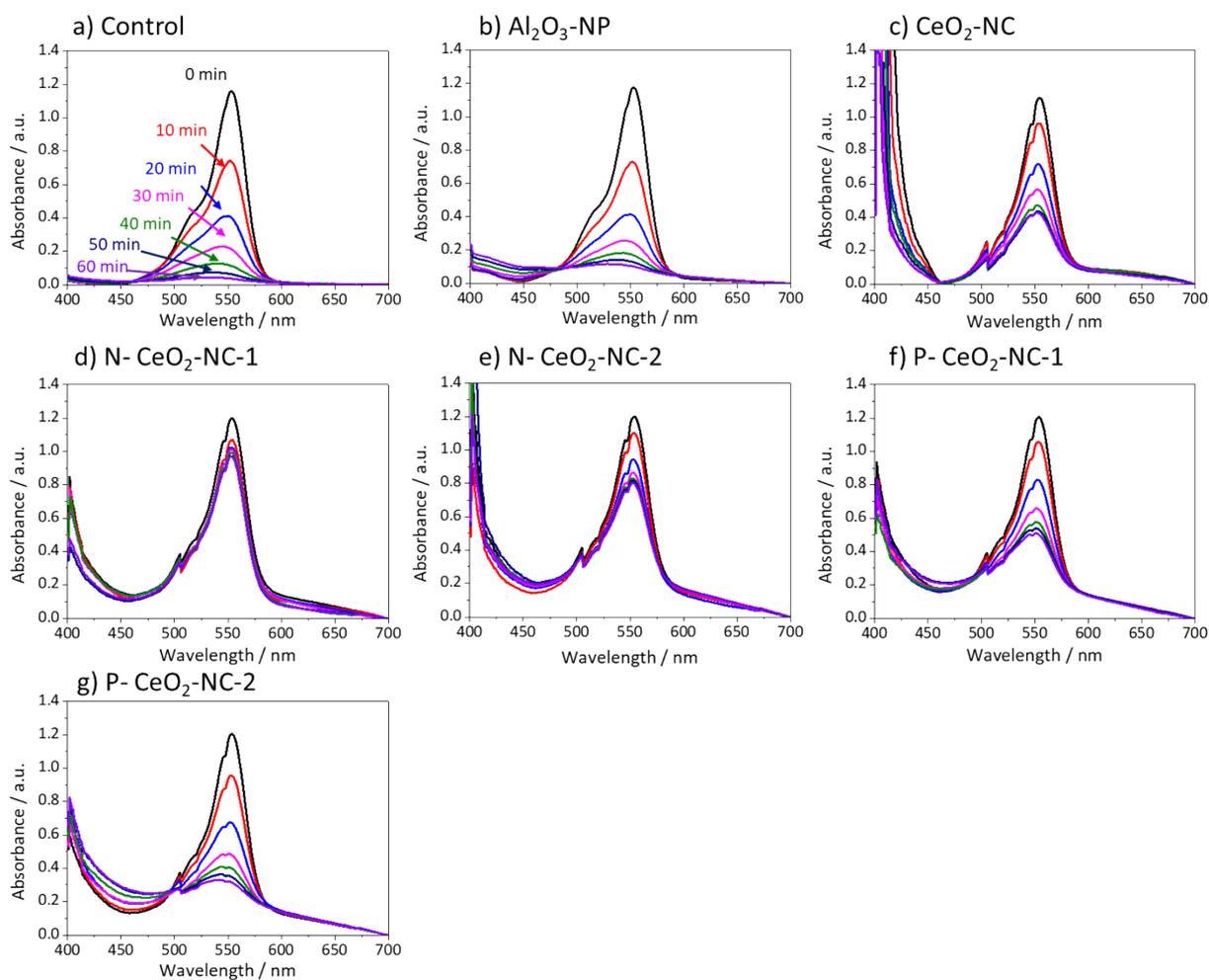


**Figure S3.** UV-Vis spectra of RhB in the control solution (initial RhB: 12.5 mol), the Fenton solution without added solid samples, measured as a function of reaction time at various temperatures: a) 286 K, b) 296 K, c) 306 K, and d) 316 K. e) The decay of relative RhB concentration (relative to the initial RhB concentration) over reaction time measured at various temperatures.



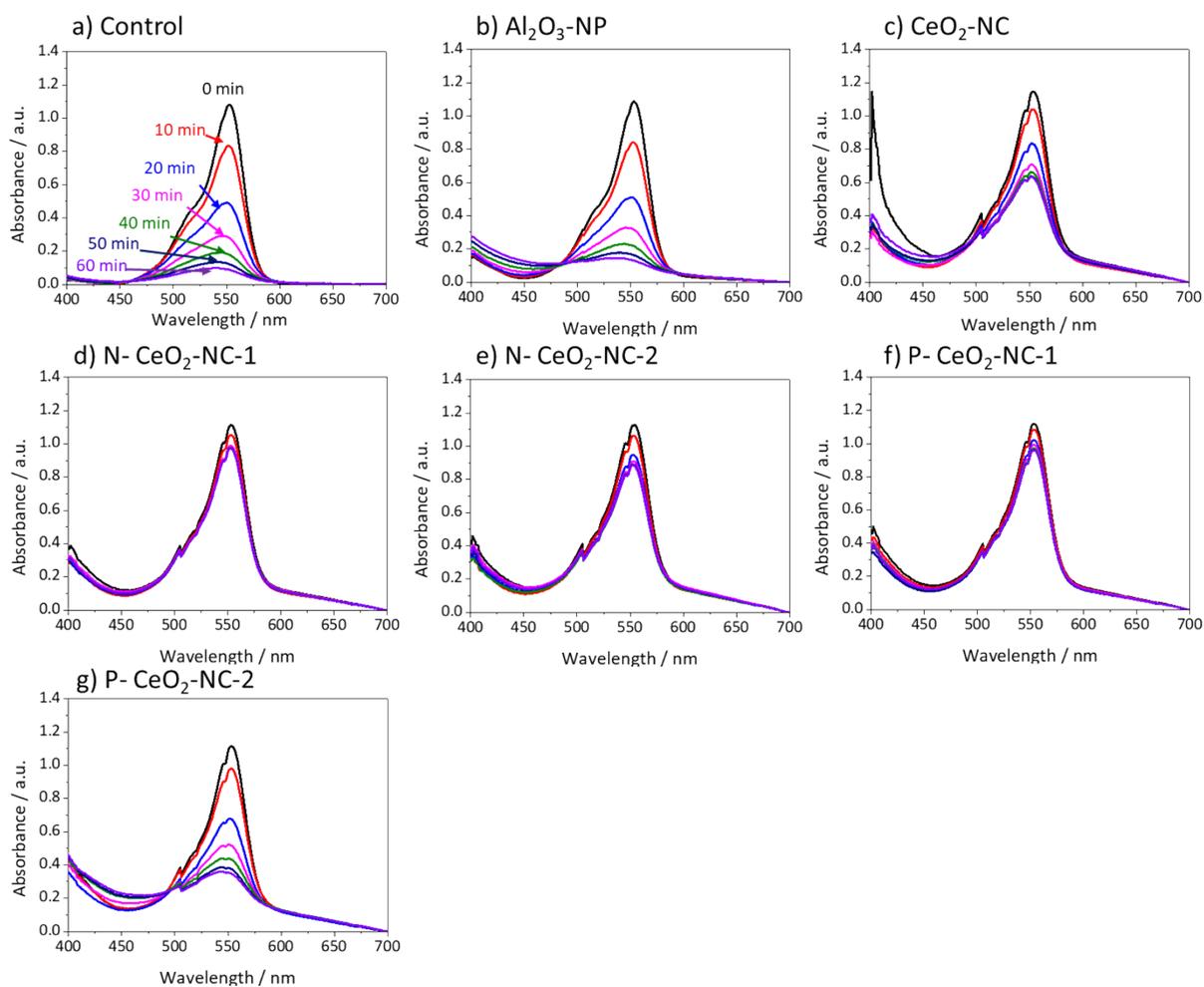
**Figure S4.** Time-dependent changes in the UV-Vis spectra of RhB in the Fenton solutions measured at 286 K. The dispersion amount of nanoparticles was fixed at  $0.2 \text{ mg mL}^{-1}$  for all the samples. The spectra correspond to the following conditions: a) control solution, and suspension of b)  $\text{Al}_2\text{O}_3$ -NP, c)  $\text{CeO}_2$ -NC, d) N- $\text{CeO}_2$ -NC-1, e) N- $\text{CeO}_2$ -NC-2, f) P- $\text{CeO}_2$ -NC-1, and g) P- $\text{CeO}_2$ -NC-2.

Fenton reaction measurement at 286 K



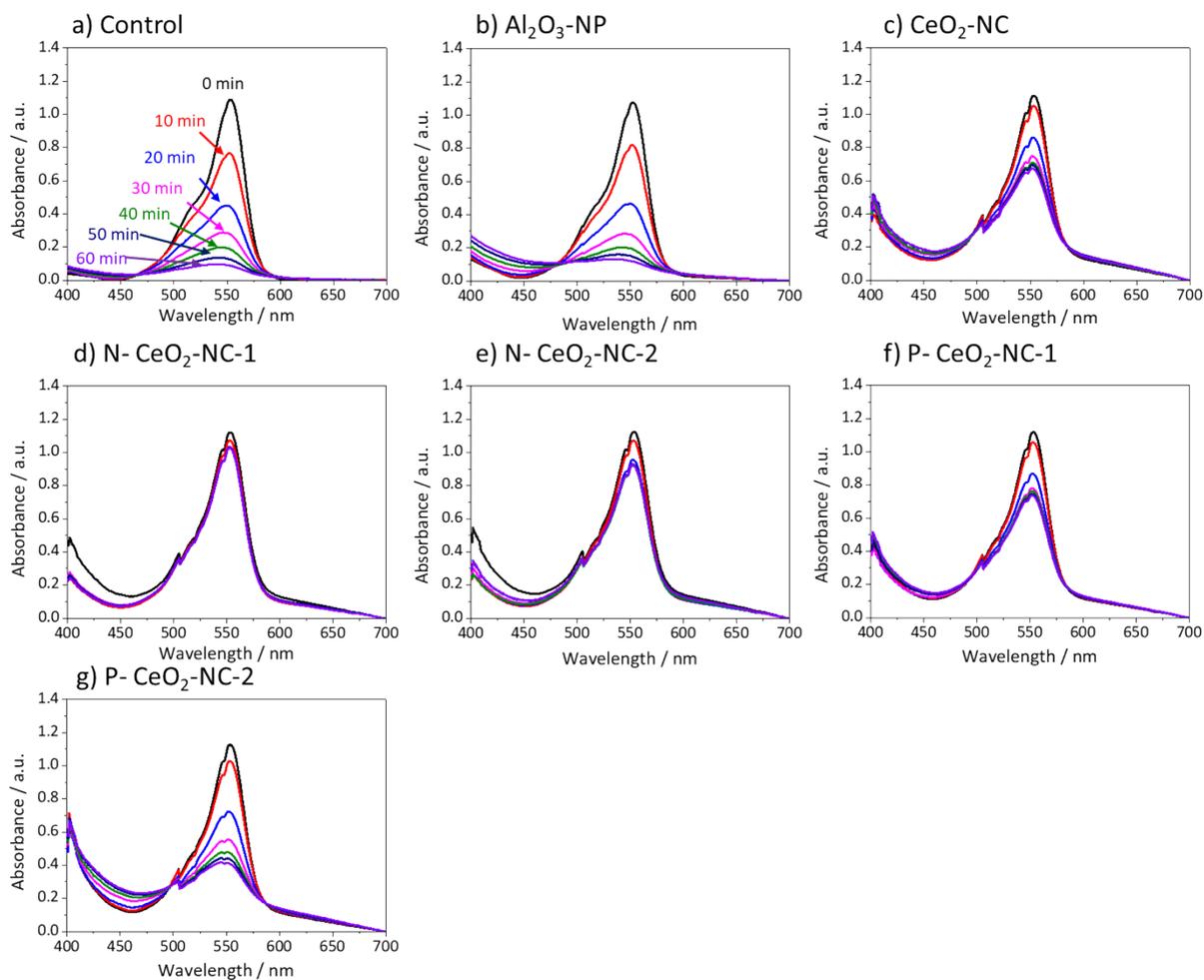
**Figure S5.** Time-dependent changes in the UV-Vis spectra of RhB in the Fenton solutions measured at 296 K. The dispersion amount of nanoparticles was fixed at  $0.2 \text{ mg mL}^{-1}$  for all the samples. The spectra correspond to the following conditions: a) control solution, and suspension of b)  $\text{Al}_2\text{O}_3\text{-NP}$ , c)  $\text{CeO}_2\text{-NC}$ , d)  $\text{N-CeO}_2\text{-NC-1}$ , e)  $\text{N-CeO}_2\text{-NC-2}$ , f)  $\text{P-CeO}_2\text{-NC-1}$ , and g)  $\text{P-CeO}_2\text{-NC-2}$ .

Fenton reaction measurement at 296 K



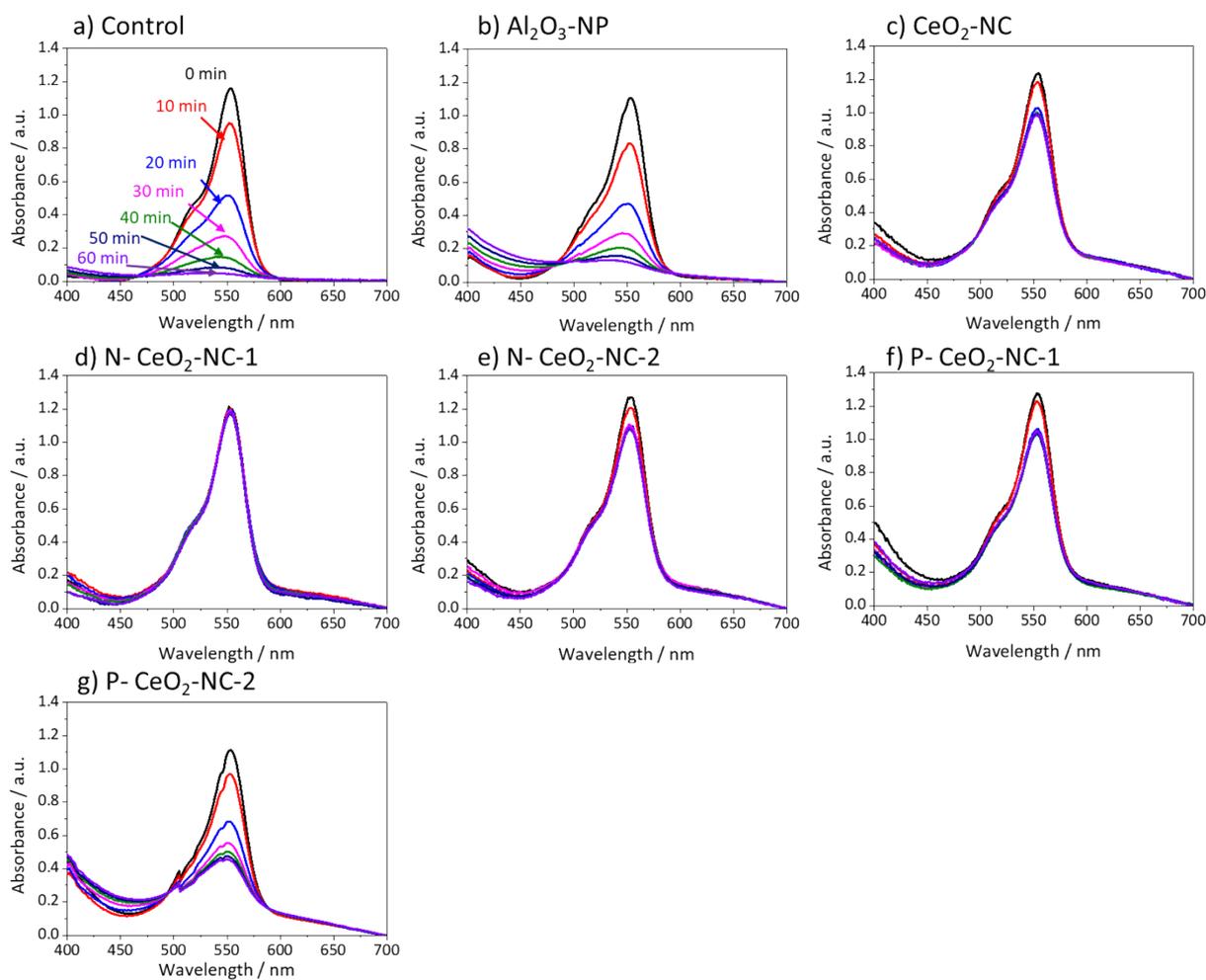
**Figure S6.** Time-dependent changes in the UV-Vis spectra of RhB in the Fenton solutions measured at 306 K. The dispersion amount of nanoparticles was fixed at  $0.2 \text{ mg mL}^{-1}$  for all the samples. The spectra correspond to the following conditions: a) control solution, and suspension of b)  $\text{Al}_2\text{O}_3$ -NP, c)  $\text{CeO}_2$ -NC, d) N- $\text{CeO}_2$ -NC-1, e) N- $\text{CeO}_2$ -NC-2, f) P- $\text{CeO}_2$ -NC-1, and g) P- $\text{CeO}_2$ -NC-2.

Fenton reaction measurement at 306 K



**Figure S7.** Time-dependent changes in the UV-Vis spectra of RhB in the Fenton solutions measured at 316 K. The dispersion amount of nanoparticles was fixed at  $0.2 \text{ mg mL}^{-1}$  for all the samples. The spectra correspond to the following conditions: a) control solution, and suspension b)  $\text{Al}_2\text{O}_3$ -NP, c)  $\text{CeO}_2$ -NC, d) N- $\text{CeO}_2$ -NC-1, e) N- $\text{CeO}_2$ -NC-2, f) P- $\text{CeO}_2$ -NC-1, and g) P- $\text{CeO}_2$ -NC-2.

Fenton reaction measurement at 316 K



**Table S1.** Synthesis conditions of CeO<sub>2</sub>-NC, N-CeO<sub>2</sub>-NCs, and P-CeO<sub>2</sub>-NCs.

	Precursor amount			Heat treatment
	Ce(NO <sub>3</sub> ) <sub>3</sub> (g) (in 5 mL DI water)	Heteroatom precursor (g) (in 5 mL DI water)	NaOH (g) (in 70 mL DI water)	
CeO <sub>2</sub> -NC	1.736	-	19.2	Air/ 673 K/ 4h
N-CeO <sub>2</sub> -NC-1		0.155 (Urea)		N <sub>2</sub> / 673 K/ 4h
N-CeO <sub>2</sub> -NC-2		0.328 (Urea)		
P-CeO <sub>2</sub> -NC-1		0.03 (DAHP)		Air/ 673 K/ 4h
P-CeO <sub>2</sub> -NC-2		0.09 (DAHP)		

**Table S2.** pH of the control solution (without suspended solid nanoparticles) and the test solution (with suspended solid nanoparticles) measured before and after the Fenton reactions (60 min) at various temperatures.

sample	Initial pH	Final pH			
		286K	296K	306K	316K
Control solution	6.6	4.2	4.2	4.0	4.6
Al <sub>2</sub> O <sub>3</sub> -NP	6.2	4.2	4.3	4.2	4.1
CeO <sub>2</sub> -NC	6.3	4.9	4.5	4.8	4.6
N-CeO <sub>2</sub> -NC-1	6.7	6.3	5.7	5.9	6.8
N-CeO <sub>2</sub> -NC-2	6.8	5.2	5.1	5.0	4.9
P-CeO <sub>2</sub> -NC-1	6.5	4.6	4.5	4.6	4.5
P-CeO <sub>2</sub> -NC-2	6.2	4.3	4.2	4.3	4.2