metals

MDPI

Supplementary Material

Table S1. The concentration of Al, Ti, and Si ions after cementation experiment of Co^{2+} in sulfate solution at initial pH 4.0 at 25 °C for 24 h.

Powder	dosage (g)	w/o 0.1g Al			w/ 0.1g Al		
		Al(ppm)	Ti(ppm)	Si(ppm)	Al(ppm)	Ti(ppm)	Si(ppm)
	-	-	-	-	0	-	-
AC	0.01	-	-	-	0.4	-	-
	0.05	-	-	-	1.4	-	-
	0.1	-	-	-	0	-	-
	0.2	-	-	-	0	-	-
	0.4	-	-	-	0.3	-	-
TiO_2	0.01	-	0	-	0.7	0	-
	0.05	-	0	-	0	0	-
	0.1	-	0	-	0	0	-
	0.2	-	0	-	0	0	-
	0.4	-	0	-	0	0	-
SiO_2	0.01	-	-	0	1.1	-	0
	0.05	-	-	0	1.1	-	0
	0.1	-	-	0	1.7	-	0
	0.2	-	-	0	1.2	-	0
	0.4	-	-	0	0	-	0

Table S1 shows the concentration of Al, Ti, and Si ions after cementation experiments of Co^{2+} in sulfate solution after 24 h using Al, AC, TiO_2, and SiO_2. The dissolution of TiO_2 and SiO_2 were not observed and the concentration of Al ions was less than 2 ppm under the whole conditions.

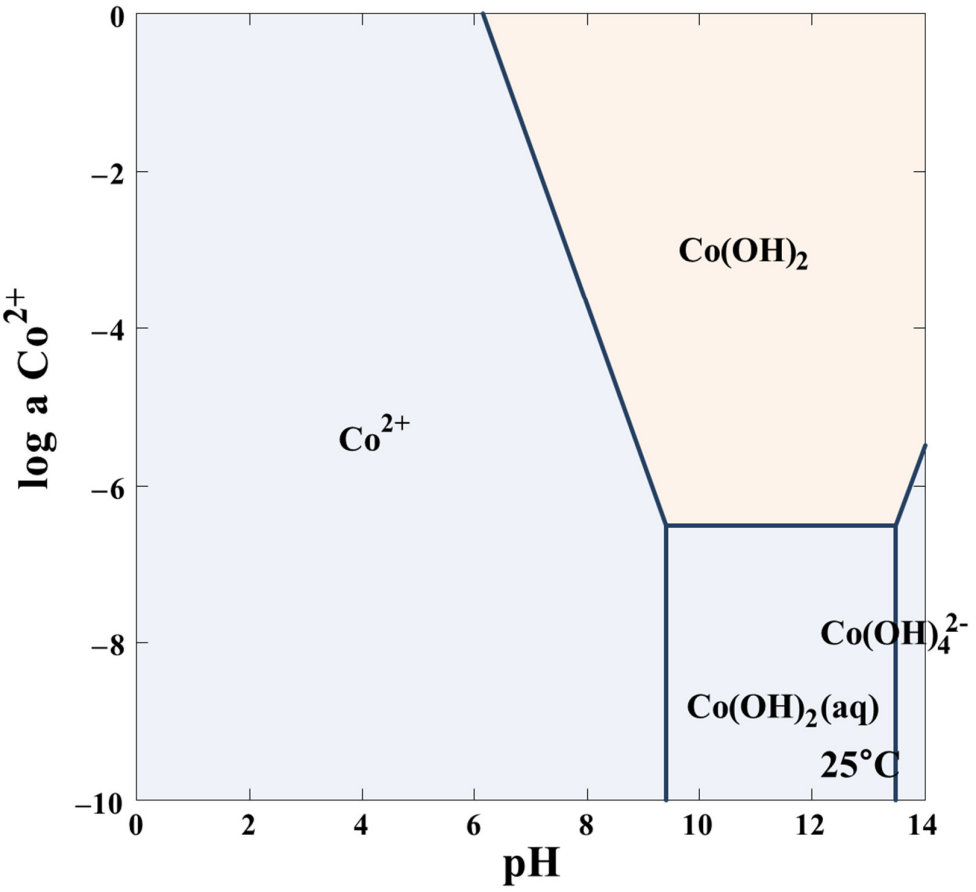


Figure S1. The activity–pH diagram for 1mM Co^{2+} species with 0.1 M SO_4^{2-} at 25 °C (created using the GWB Professional Ver. 12.0.3 software).

The activity–pH diagram for 1mM Co^{2+} in 0.1 M SO_4^{2-} confirms that Co^{2+} are not precipitated as Co hydroxide at pH 5.5 in Figure S1 (the maximum final pH in the whole condition).

Table S2. The concentration of Al, Ti, and Si ions after cementation experiment of Ni^{2+} in sulfate solution at initial pH 4.0 for 24 h

		w/o 0.1g Al			w/ 0.1g Al		
Powder	dosage (g)	Al(ppm)	Ti(ppm)	Si(ppm)	Al(ppm)	Ti(ppm)	Si(ppm)
	-	-	-	-	0	-	-
AC	0.01	-	-	-	0.9	-	-
	0.05	-	-	-	1.0	-	-
	0.1	-	-	-	0.0	-	-
	0.2	-	-	-	0.0	-	-
	0.4	-	-	-	0.0	-	-
TiO_2	0.01	-	0	-	2.7	0	-
	0.05	-	0	-	2.6	0	-
	0.1	-	0	-	3.0	0	-
	0.2	-	0	-	0.0	0	-
	0.4	-	0	-	0.0	0	-
SiO_2	0.01	-	-	0	1.2	-	0
	0.05	-	-	0	2.2	-	0
	0.1	-	-	0	2.0	-	0
	0.2	-	-	0	0.0	-	0
	0.4	-	-	0	0.5	-	0

Table S2 shows the concentration of Al, Ti, and Si ions after cementation experiments of Ni^{2+} in sulfate solution after 24 h using Al, AC, TiO_2, and SiO_2. The dissolution of TiO_2 and SiO_2 were not observed and the concentration of Al ions was less than 3 ppm under the whole conditions.

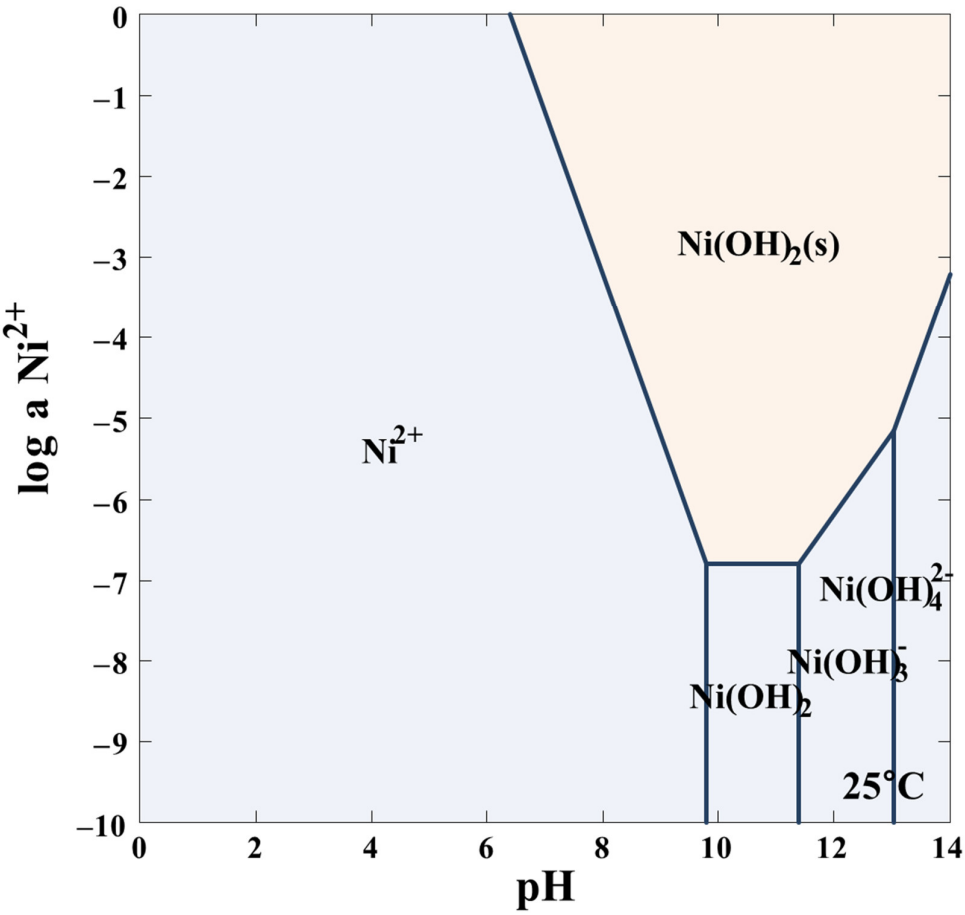


Figure S2. The activity–pH diagram for 1mM Ni^{2+} species with 0.1 M SO_4^{2-} at 25 °C (created using the GWB Professional Ver. 12.0.3 software).

The activity–pH diagram for 1mM Ni^{2+} in 0.1 M SO_4^{2-} confirms that Ni^{2+} are not precipitated as Ni hydroxide at pH 5.6 in Figure S2 (the maximum final pH in the whole condition).

Table S3. The concentration of Al, Ti, and Si ions after cementation experiment of Co^{2+} in chloride solution at initial pH 4.0 at 25 °C for 24 h

		w/o 0.1g Al			w/ 0.1g Al		
Powder	dosage (g)	Al(ppm)	Ti(ppm)	Si(ppm)	Al(ppm)	Ti(ppm)	Si(ppm)
	-	-	-	-	2.0	-	-
AC	0.01	-	-	-	1.0	-	-
	0.05	-	-	-	3.6	-	-
	0.1	-	-	-	0	-	-
	0.2	-	-	-	0	-	-
	0.4	-	-	-	0	-	-
TiO_2	0.01	-	0	-	3.0	0	-
	0.05	-	0	-	4.9	0	-
	0.1	-	0	-	1.2	0	-
	0.2	-	0	-	4.9	0	-
	0.4	-	0	-	1.0	0	-
SiO_2	0.01	-	-	0	3.9	-	0
	0.05	-	-	0	1.0	-	0
	0.1	-	-	0	3.5	-	0
	0.2	-	-	0	3.1	-	0
	0.4	-	-	0	4.2	-	0

Table S3 shows the concentration of Al, Ti, and Si ions after cementation experiments of Co^{2+} in chloride solution after 24 h using Al, AC, TiO_2, and SiO_2. The dissolution of TiO_2 and SiO_2 were not observed and the concentration of Al ions was less than 5 ppm under the whole conditions.

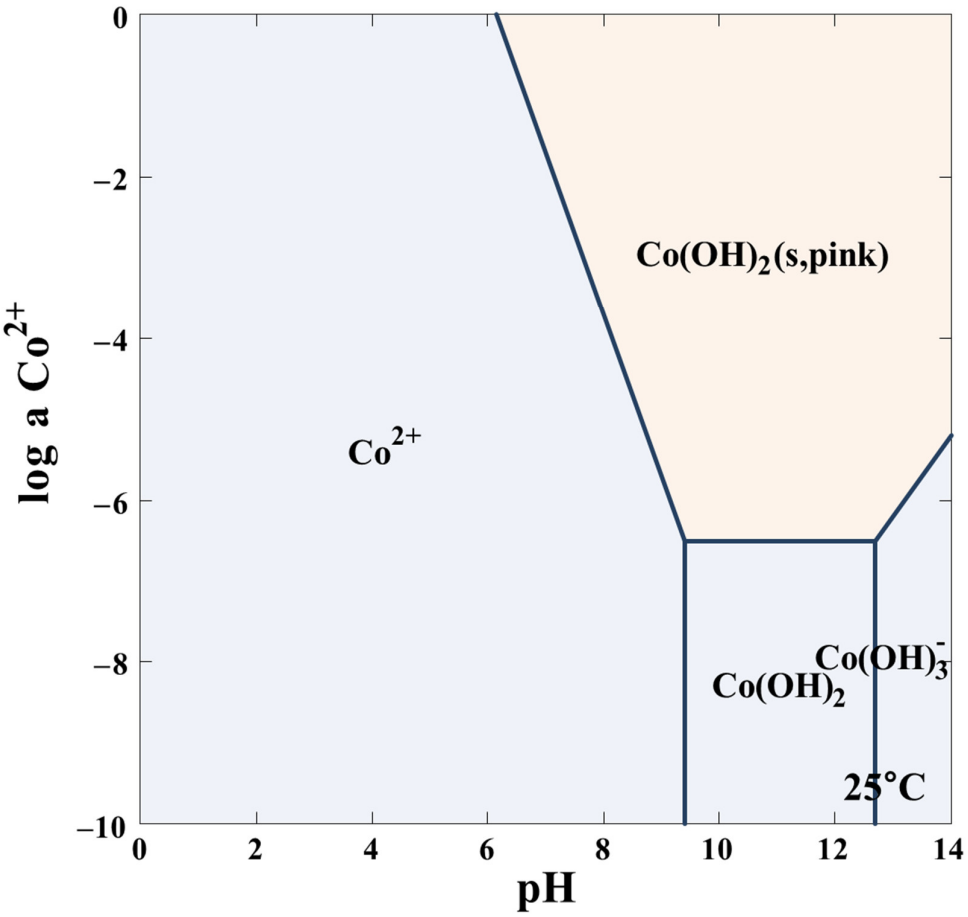


Figure S3. The activity–pH diagram for 1mM Co^{2+} species with 0.1 M Cl^- at 25 °C (created using the GWB Professional Ver. 12.0.3 software).

The activity–pH diagram for 1mM Co^{2+} in 0.1 M Cl^- confirms that Co^{2+} are not precipitated as Co hydroxide at pH 5.5 in Figure S3 (the maximum final pH in the whole condition).

Table S4. The concentration of Al, Ti, and Si ions after cementation experiment of Ni^{2+} in chloride solution at initial pH 4.0 for 24 h

		w/o 0.1g Al			w/ 0.1g Al		
Powder	dosage (g)	Al(ppm)	Ti(ppm)	Si(ppm)	Al(ppm)	Ti(ppm)	Si(ppm)
	-	-	-	-	0	-	-
AC	0.01	-	-	-	0.2	-	-
	0.05	-	-	-	0	-	-
	0.1	-	-	-	0.5	-	-
	0.2	-	-	-	0.2	-	-
	0.4	-	-	-	0	-	-
TiO_2	0.01	-	0	-	0	0	-
	0.05	-	0	-	0.5	0	-
	0.1	-	0	-	0	0	-
	0.2	-	0	-	1.2	0	-
	0.4	-	0	-	0	0	-
SiO_2	0.01	-	-	0	1.2	-	0
	0.05	-	-	0	2.2	-	0
	0.1	-	-	0	2.0	-	0
	0.2	-	-	0	1.0	-	0
	0.4	-	-	0	0.9	-	0

Table S4 shows the concentration of Al, Ti, and Si ions after cementation experiments of Ni^{2+} in chloride solution after 24 h using Al, AC, TiO_2, and SiO_2. The dissolution of TiO_2 and SiO_2 were not observed and the concentration of Al ions was less than 3 ppm under the whole conditions.

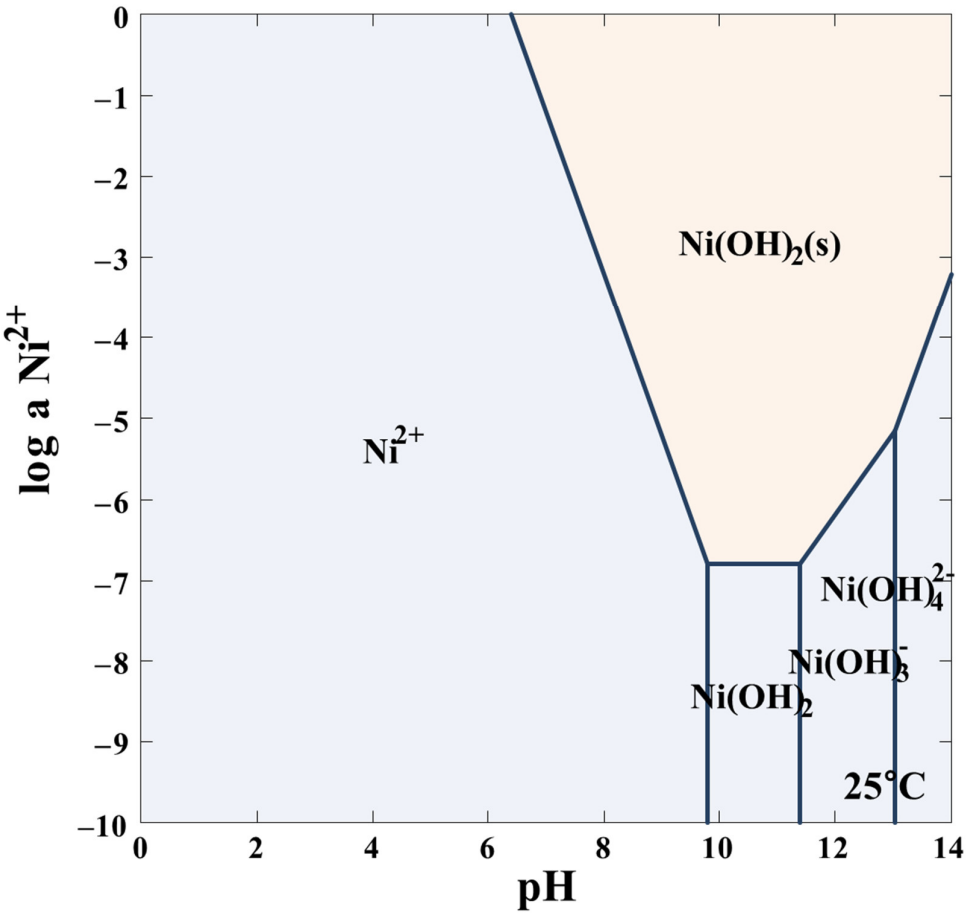


Figure S2. The activity–pH diagram for 1mM Ni^{2+} species with 0.1 M Cl^- at 25 °C (created using the GWB Professional Ver. 12.0.3 software).

The activity–pH diagram for 1mM Ni^{2+} in 0.1 M Cl^- confirms that Ni^{2+} are not precipitated as Ni hydroxide at pH 6.1 in Figure S4 (the maximum final pH in the whole condition).