Electronic Supporting Information

A family of fourteen soluble stable macrocyclic [Ni$^{II}_3$Ln$^{III}$] complexes

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Figure S1. Perspective view of the crystal structure of [Ni$^{II}_3$Yb$^{III}$(L$^{Ld}$)$_3$(NO$_3$)$_2$(MeOH)$_{4.75}$(H$_2$O)$_{1.25}$]$^+$. For clarity, non-acidic hydrogen atoms and parts of the disordered atoms have been omitted. Selected bond lengths (Å): Yb(1)-O(2), 2.474(5); Yb(1)-O(3), 2.469(5); Yb(1)-O(6), 2.478(6); Yb(1)-O(7), 2.458(5); Yb(1)-O(10), 2.449(5); Yb(1)-O(11), 2.458(5); Yb(1)-O(30), 2.404(7); Yb(1)-O(31), 2.414(6); Yb(1)-O(40), 2.427(8); Yb(1)-O(41), 2.463(7); Ni(1)-O(1), 2.011(6); Ni(1)-O(2), 1.961(6); Ni(1)-O(11), 1.974(6); Ni(1)-O(12), 2.000(7); Ni(1)-O(60), 2.116(16); Ni(1)-O(61), 2.059(11); Ni(1)-O(70), 2.091(7); Ni(2)-O(3), 1.975(5); Ni(2)-O(4), 2.005(6); Ni(2)-O(5), 2.011(6); Ni(2)-O(6), 1.974(6); Ni(2)-O(80), 2.059(8); Ni(2)-O(81), 2.08(3); Ni(2)-O(90), 2.086(8); Ni(3)-O(7), 1.964(5); Ni(3)-O(8), 2.010(7); Ni(3)-O(9), 2.003(6); Ni(3)-O(10), 1.982(5); Ni(3)-O(100), 2.055(7); Ni(3)-O(110), 2.237(15); Ni(3)-O(111), 1.983(16). Selected angles (°): Ni(1)-O(2)-Yb(1), 111.0(2); Ni(1)-O(11)-Yb(1), 111.2(2); Ni(2)-O(3)-Yb(1), 110.5(2); Ni(2)-O(6)-Yb(1), 110.2(2); Ni(3)-O(7)-Yb(1), 111.0(2); Ni(3)-O(10)-Yb(1), 110.7(2).
**Figure S2.** Temperature dependence of the $\chi T$ product for [Ni$^{II3}$La$^{III}(\text{L}^\text{Pr})$] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

**Figure S3.** Temperature dependence of the $\chi T$ product for [Ni$^{II3}$Ce$^{III}(\text{L}^\text{Pr})$] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

**Figure S4.** Temperature dependence of the $\chi T$ product for [Ni$^{II3}$Pr$^{III}(\text{L}^\text{Pr})$] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).
Figure S5. Temperature dependence of the $\chi T$ product for [Ni$^{II}_3$Nd$^{III}$($L^{Pr}$)] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

Figure S6. Temperature dependence of the $\chi T$ product for [Ni$^{II}_3$Sm$^{III}$($L^{Pr}$)] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

Figure S7. Temperature dependence of the $\chi T$ product for [Ni$^{II}_3$Eu$^{III}$($L^{Pr}$)] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).
Figure S8. Temperature dependence of the $\chi T$ product for [Ni$^{III}$Gd$^{III}$($L^p$)] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

Figure S9. Temperature dependence of the $\chi T$ product for [Ni$^{III}$Tb$^{III}$($L^p$)] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

Figure S10. Temperature dependence of the $\chi T$ product for [Ni$^{III}$Dy$^{III}$($L^p$)] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).
Figure S11. Temperature dependence of the $\chi T$ product for [Ni$^{II}$_3Ho$^{III}$($L$)$_{Pr}$] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

Figure S12. Temperature dependence of the $\chi T$ product for [Ni$^{II}$_3Er$^{III}$($L$)$_{Pr}$] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

Figure S13. Temperature dependence of the $\chi T$ product for [Ni$^{II}$_3Tm$^{III}$($L$)$_{Pr}$] (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).
Figure S14. Temperature dependence of the $\chi T$ product for $[\text{Ni}^\text{II}_3\text{Yb}^\text{III}(\text{L}^\text{Pr})]$ (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

Figure S15. Temperature dependence of the $\chi T$ product for $[\text{Ni}^\text{II}_3\text{Lu}^\text{III}(\text{L}^\text{Pr})]$ (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex).

Figure S16. Temperature dependence of the $\chi T$ product in a 1000 Oe dc field (with $\chi$ defined as the molar magnetic susceptibility at 1000 Oe and equal to $M/H$ per mole of complex) for $[\text{Ni}^\text{II}_3\text{La}^\text{III}(\text{L}^\text{Pr})]$, $[\text{Zn}^\text{II}_3\text{Dy}^\text{III}(\text{L}^\text{Pr})]$, $[\text{Ni}^\text{II}_3\text{Dy}^\text{III}(\text{L}^\text{Pr})]$ and the remainder after subtraction of the two analogues.
Figure S17. (Left) Field dependence of magnetisation for \([\text{Ni}^{II}_3\text{La}^{III}(\text{L}^{Pr})]\) at the temperatures indicated, scanning at 100 – 200 Oe.min\(^{-1}\). (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S18. (Left) Field dependence of magnetisation for \([\text{Ni}^{II}_3\text{Ce}^{III}(\text{L}^{Pr})]\) at the temperatures indicated, scanning at 100 – 200 Oe.min\(^{-1}\). (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S19. (Left) Field dependence of magnetisation for \([\text{Ni}^{II}_3\text{Pr}^{III}(\text{L}^{Pr})]\) at the temperatures indicated, scanning at 100 – 200 Oe.min\(^{-1}\). (Right) Field dependence of reduced magnetisation at the temperatures indicated.
Figure S20. (Left) Field dependence of magnetisation for [Ni$^{II}_3$Nd$^{III}$(L$^{Pr}$)] at the temperatures indicated, scanning at 100 – 200 Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S21. (Left) Field dependence of magnetisation for [Ni$^{II}_3$Sm$^{III}$(L$^{Pr}$)] at the temperatures indicated, scanning at 100 – 200 Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S22. (Left) Field dependence of magnetisation for [Ni$^{II}_3$Eu$^{III}$(L$^{Pr}$)] at the temperatures indicated, scanning at 100 – 200 Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.
Figure S23. (Left) Field dependence of magnetisation for [Ni$^{III}_{3}$Gd$^{III}$($L^{Pr}$)] at the temperatures indicated, scanning at 100 – 200 Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S24. (Left) Field dependence of magnetisation for [Ni$^{III}_{3}$Tb$^{III}$($L^{Pr}$)] at the temperatures indicated, scanning at 100 – 200 Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S25. (Left) Field dependence of magnetisation for [Ni$^{III}_{3}$Dy$^{III}$($L^{Pr}$)] at the temperatures indicated, scanning at 100 – 200 Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.
Figure S26. (Left) Field dependence of magnetisation for $[\text{Ni}^{II}_3\text{Ho}^{III}(\text{L}^{Pr})]$ at the temperatures indicated, scanning at $100 – 200$ Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S27. (Left) Field dependence of magnetisation for $[\text{Ni}^{II}_3\text{Er}^{III}(\text{L}^{Pr})]$ at the temperatures indicated, scanning at $100 – 200$ Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S28. (Left) Field dependence of magnetisation for $[\text{Ni}^{II}_3\text{Tm}^{III}(\text{L}^{Pr})]$ at the temperatures indicated, scanning at $100 – 200$ Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.
Figure S29. (Left) Field dependence of magnetisation for $[\text{Ni}^{II}_3\text{Yb}^{III}(\text{L}^{Pr})]$ at the temperatures indicated, scanning at 100 – 200 Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S30. (Left) Field dependence of magnetisation for $[\text{Ni}^{II}_3\text{Lu}^{III}(\text{L}^{Pr})]$ at the temperatures indicated, scanning at 100 – 200 Oe.min$^{-1}$. (Right) Field dependence of reduced magnetisation at the temperatures indicated.

Figure S31. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for $[\text{Ni}^{II}_3\text{La}^{III}(\text{L}^{Pr})]$ at 1000 Hz with an amplitude of the ac field of 3 Oe.
Figure S32. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for [Ni$^{	ext{II}}$$_3$Ce$^{	ext{III}}$(L$^{	ext{Pr}}$)] at 1000 Hz with an amplitude of the ac field of 3 Oe.

Figure S33. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for [Ni$^{	ext{II}}$_3Pr$^{	ext{III}}$(L$^{	ext{Pr}}$)] at 1000 Hz with an amplitude of the ac field of 3 Oe.

Figure S34. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for [Ni$^{	ext{II}}$_3Nd$^{	ext{III}}$(L$^{	ext{Pr}}$)] at 1000 Hz with an amplitude of the ac field of 3 Oe.
Figure S35. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for $[\text{Ni}^{II}_3\text{Sm}^{III}(L^{Pr})]$ at 1000 Hz with an amplitude of the ac field of 3 Oe.

Figure S36. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for $[\text{Ni}^{II}_3\text{Eu}^{III}(L^{Pr})]$ at 1000 Hz with an amplitude of the ac field of 3 Oe.

Figure S37. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for $[\text{Ni}^{II}_3\text{Gd}^{III}(L^{Pr})]$ at 1000 Hz with an amplitude of the ac field of 3 Oe.
Figure S38. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for $[\text{Ni}^{II}_3\text{Tb}^{III}(L^{Pr})]$ at 1000 Hz with an amplitude of the ac field of 3 Oe.

Figure S39. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for $[\text{Ni}^{II}_3\text{Dy}^{III}(L^{Pr})]$ at 1000 Hz with an amplitude of the ac field of 3 Oe.

Figure S40. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for $[\text{Ni}^{II}_3\text{Ho}^{III}(L^{Pr})]$ at 1000 Hz with an amplitude of the ac field of 3 Oe.
Figure S41. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for [Ni$^{II}$,Er$^{III}$($L^{Pr}$)] at 1000 Hz with an amplitude of the ac field of 3 Oe.

Figure S42. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for [Ni$^{II}$,Tm$^{III}$($L^{Pr}$)] at 1000 Hz with an amplitude of the ac field of 3 Oe.

Figure S43. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for [Ni$^{II}$,Yb$^{III}$($L^{Pr}$)] at 1000 Hz with an amplitude of the ac field of 3 Oe.
Figure S44. Temperature dependence below 10 K of the in- and out-of-phase components of ac susceptibility for [Ni$^{II}_3$Lu$^{III}$(L$^P$)] at 1000 Hz with an amplitude of the ac field of 3 Oe.