Salicylaldoxime Derivatives for New Magnetic Materials

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Abstract

Salicylaldoxime (H_2Sao) is an appealing unit for metal ion coordination, specifically that of transition metal (3*d*) ions. During this research, four ligands were synthesised, of which two were previously unknown (**L2** and **L3**). These ligands differed by the secondary amine added to the simple H_2Sao molecule. These H_2Sao derived ligands were complexed with a variety of 3*d* ions, resulting in three distinct topologies: mononuclear, triangular, and defective dicubane. The nine new complexes (**C1**-**C9**) synthesised were all structurally characterised, with Mössbauer spectroscopy performed on the iron complexes, and magnetic characterisation performed on complexes **C1**-**C6**, **C8**-**C9**. Analysis of the synthesised complexes has led to new insights into magnetostructural correlations and new pathways to unique ligand designs.

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Abbreviations

χ	Magnetic susceptibility
χ_M	Molar Magnetic Susceptibility
D	Zero field splitting
δ	Isomer shift
ΔE_Q	Quadrupole splitting
Γ_L	Line width of the left peak
Γ_R	Line width of the right peak
E	Energy
T_B	Blocking temperature
μ_B	Bohr magneton
μ_{eff}	Effective barrier for reversal of magnetisation
$3d$	First row transition metal
$4f$	Lanthanide
$Acac^-$	Acetylacetonate anion
Ar	Aryl group
B	Applied magnetic field
BF_4^-	Tetrafluoroborate anion
Bn	Benzyl group
CCDC	Cambridge Crystallographic Database Centre
$CDCl_3$	Deuterated chloroform
$(CHO)_n$	Paraformaldehyde
ClO_4^-	Perchlorate anion
DC	Direct current
ESI-MS	Electrospray ionisation mass spectrometry
fac	Facial coordination geometry
FT	Fourier transformation
ATR-FTIR	Attenuated total reflection - Fourier transform infrared spectroscopy
HPLC	High performance liquid chromatography
HSal	Salicylaldehyde

H_2Sao	Salicylaldoxime
H_2Sai	Salicylaldimine
IPA	Isopropyl alcohol
IS	Isomer Shift
K	Kelvin
LNT	Liquid nitrogen temperature
M	Magnetisation
Me	Methyl group
mer	Meridional coordination geometry
$NH_2OH{\cdot}HCl$	Hydroxylamine hydrochloride
NO_3^-	Nitrate anion
OAc^-	Acetate anion
OH^-	Hydroxide anion
OMe^-	Methoxide anion
QS	Quadrupole splitting
QTM	Quantum tunnelling of magnetisation
R_F	Retention factor
S	Total spin angular momentum
SMMs	Single molecule magnets
SO_4^{2-}	Sulfate anion
SQUID	Superconducting quantum interference device
^{t}Bu	*Tert*-butyl group
XRD	X-ray diffraction
ZFS	Zero field splitting