Crystal structure of (μ_4-oxygen)tetra(2-(4′-chlorobenzoyl)benzoato)trilead(II), $Pb_3O(C_{14}H_8O_3Cl)_4$

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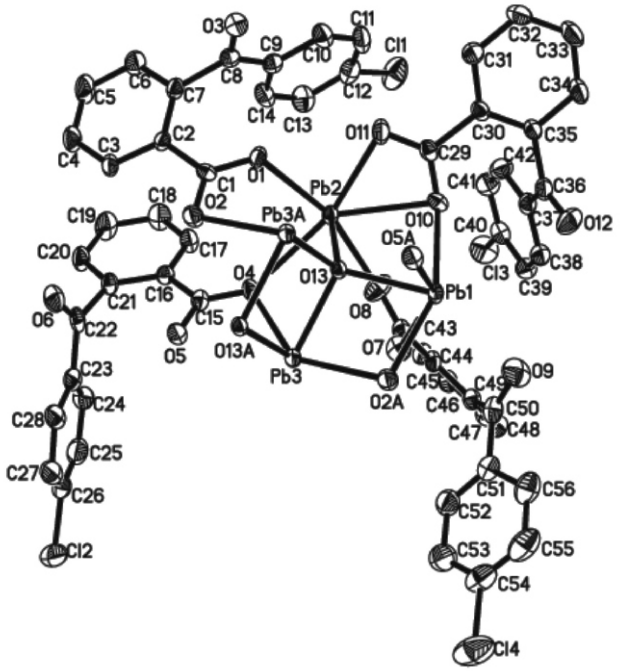

Abstract

$C_{112}H_{64}Cl_8O_{26}Pb_6$, monoclinic, $P2_1/n$ (no. 14), a = 11.4546(9) Å, b = 15.414(1) Å, c = 30.348(2) Å, β = 92.271(1)°, V = 5353.9 Å^3, Z = 2, $R_{gt}(F)$ = 0.030, $wR_{ref}(F^2)$ = 0.077, T = 292 K.

Source of material

The title compound was prepared from a mixture of $Pb(NO_3)_2$ (0.066 g, 0.2 mmol), 2-(4′-chlorobenzoyl)benzoic acid (Hcbba, 0.052 g, 0.2 mmol), and H_2O (18 mL) in a 30 mL Teflon-lined autoclave under autogenous pressure at 150 °C for seven days. After cooling to room temperature, colorless block-shaped crystals were collected by filtration and washed with distilled water in 39 % yield (based on Pb). Elemental analysis — found: C, 40.10 %; H, 1.89 %; calculated for $C_{112}H_{64}Cl_8O_{26}Pb_6$: C, 40.13 %; H, 1.92 %.

Discussion

Recently, the design and synthesis of coordination compounds have attracted much attention due to their structural diversity [1-2] and potential applications [2-8]. A successful strategy for preparing coordination compounds is the assembly reaction between a transition metal ion and two types of organic ligands, one acting as a terminal and the other as a bridging ligand. In this aspect, the rigid and versatile ligand 2-(4′-chlorobenzoyl)benzoic acid (Hcbba) has been relatively less studied for constructing coordination compounds containing transition metals [9-10].

In the title crystal structure, the asymmetric unit contains three Pb(II) atoms, one μ_4-oxygen atom and four 2-(4′-chlorobenzoyl)-benzoate (cbba) ligands. The Pb1 atom is five-coordinated by four carboxylate oxygen atoms (O2A (A: x+½,y+½,–z+⅗), O5A, O7, O10) from four different cbba ligands and one oxygen atom (μ_4-O13), showing a distorted square-pyramidal coordination (d(Pb1—O2A) = 2.414(4) Å, d(Pb1—O5A) = 2.641(4) Å, d(Pb1—O7) = 2.459(4) Å, d(Pb1—O10) = 2.594(4) Å, d(Pb1—O13) = 2.316(3) Å). The Pb2 atom is six-coordinated by five carboxylate oxygen atoms (O1, O4, O8, O10, O11) from four different cbba ligands and one oxygen atom (μ_4-O13), forming a distorted pentagonal pyramid (d(Pb2—O1) = 2.575(3) Å, d(Pb2—O4) = 2.652(4) Å, d(Pb2—O8) = 2.561(4) Å, d(Pb2—O10) = 2.639(4) Å, d(Pb2—O11) = 2.530(4) Å, d(Pb2—O13) = 2.265(3) Å). The Pb3 atom is four-coordinated by two carboxylate oxygen atoms (O2A, O4) from four different cbba ligands and two oxygen atom (μ_4-O13, μ_4-O13A), forming a distorted tetrahedron (d(Pb3—O2A) = 2.644(4) Å, d(Pb3—O4) = 2.553(4) Å, d(Pb3—O13) = 2.351(3) Å, d(Pb3—O13A) = 2.342(3) Å). The O(N)–Pb–O(N) angles range from 50.18(12)° to 164.73(15)°. Two coordination modes of the cbba ligand are present in the title crystal structure, namely μ_3 and μ_4 bridging mode. As a result, the carboxyl oxygen and μ_4-oxygen atoms link the Pb atoms to form a hexanuclear compound.

Table 1. Data collection and handling.

Crystal:	colorless block, size 0.08 × 0.10 × 0.12 mm
Wavelength:	Mo K_α radiation (0.71073 Å)
μ:	96.75 cm^{-1}
Diffractometer, scan mode:	Bruker APEX II CCD, φ/ω
$2\theta_{max}$:	52.06°
$N(hkl)_{measured}$, $N(hkl)_{unique}$:	33461, 1050
Criterion for I_{obs}, $N(hkl)_{gt}$:	$I_{obs} > 2\,\sigma(I_{obs})$, 8890
$N(param)_{refined}$:	685
Programs:	SHELXS-97, SHELXL-97, SHELXTL [11]

Table 2. Atomic coordinates and displacement parameters (in Å^2).

Atom	Site	x	y	z	U_{iso}
H(38A)	4*e*	–0.3774	–0.3062	0.3644	0.062
H(4A)	4*e*	0.1632	0.4339	0.4117	0.066
H(47A)	4*e*	–0.7803	–0.1645	0.4086	0.054
H(48A)	4*e*	–0.6611	–0.2389	0.4584	0.055
H(18A)	4*e*	–0.1878	0.3374	0.3357	0.077
H(11A)	4*e*	0.0596	–0.0557	0.2345	0.074

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Table 2. Continued.

Atom	Site	*x*	*y*	*z*	U_{iso}
H(13A)	4*e*	–0.1475	0.1437	0.2652	0.074
H(41A)	4*e*	–0.3466	–0.1179	0.2467	0.070
H(45A)	4*e*	–0.5151	–0.0116	0.3779	0.055
H(17A)	4*e*	–0.1801	0.2174	0.3812	0.057
H(10A)	4*e*	0.2043	–0.0006	0.2819	0.062
H(3A)	4*e*	0.1408	0.3060	0.4501	0.049
H(6A)	4*e*	0.2361	0.2992	0.3035	0.070
H(14A)	4*e*	0.0011	0.1981	0.3118	0.064
H(46A)	4*e*	–0.7109	–0.0482	0.3698	0.056
H(31A)	4*e*	0.1894	–0.1826	0.3098	0.056
H(34A)	4*e*	–0.0659	–0.4117	0.2857	0.069
H(20A)	4*e*	–0.1006	0.4883	0.4392	0.061
H(39A)	4*e*	–0.5394	–0.2312	0.3375	0.065

Table 2. Continued.

Atom	Site	*x*	*y*	*z*	U_{iso}
H(42A)	4*e*	–0.1838	–0.1943	0.2734	0.065
H(5A)	4*e*	0.2119	0.4299	0.3394	0.079
H(32A)	4*e*	0.2401	–0.2954	0.2644	0.069
H(33A)	4*e*	0.1072	–0.4062	0.2493	0.077
H(19A)	4*e*	–0.1492	0.4738	0.3653	0.079
H(24A)	4*e*	–0.2994	0.4206	0.4930	0.067
H(28A)	4*e*	–0.0591	0.3682	0.5890	0.068
H(52A)	4*e*	–0.5449	–0.1197	0.5287	0.076
H(27A)	4*e*	–0.1993	0.3850	0.6407	0.082
H(56A)	4*e*	–0.4081	–0.3574	0.5333	0.085
H(25A)	4*e*	–0.4356	0.4471	0.5463	0.088
H(53A)	4*e*	–0.5827	–0.1294	0.6036	0.089
H(55A)	4*e*	–0.4564	–0.3692	0.6064	0.102

Table 3. Atomic coordinates and displacement parameters (in $Å^2$).

Atom	Site	*x*	*y*	*z*	U_{11}	U_{22}	U_{33}	U_{12}	U_{13}	U_{23}
Pb(1)	4*e*	–0.11281(2)	–0.18944(1)	0.460215(6)	0.0431(1)	0.0213(1)	0.0286(1)	–0.00572(8)	–0.00200(8)	–0.00039(7)
Pb(2)	4*e*	–0.08407(2)	0.00734(1)	0.391938(6)	0.0390(1)	0.0249(1)	0.0252(1)	–0.00288(8)	–0.00257(8)	0.00203(7)
Pb(3)	4*e*	–0.14912(2)	0.02241(1)	0.513641(6)	0.0337(1)	0.0253(1)	0.0303(1)	–0.00242(8)	0.00145(8)	–0.00197(8)
Cl(3)	4*e*	–0.5791(2)	–0.1107(2)	0.26934(7)	0.072(1)	0.089(2)	0.089(2)	0.019(1)	–0.009(1)	0.008(1)
Cl(1)	4*e*	–0.1639(2)	–0.0011(2)	0.20913(8)	0.095(2)	0.096(2)	0.076(2)	–0.041(1)	–0.032(1)	0.003(1)
O(3)	4*e*	0.3101(4)	0.1030(3)	0.3326(1)	0.052(2)	0.048(3)	0.050(3)	–0.001(2)	0.003(2)	–0.002(2)
C(2)	4*e*	0.1665(4)	0.2253(3)	0.3995(2)	0.034(3)	0.026(3)	0.033(3)	–0.005(2)	0.001(2)	0.002(2)
O(13)	4*e*	–0.0424(3)	–0.0486(2)	0.4598(1)	0.037(2)	0.023(2)	0.023(2)	–0.003(1)	–0.002(1)	–0.001(1)
C(44)	4*e*	–0.4693(5)	–0.1027(4)	0.4226(2)	0.040(3)	0.032(3)	0.045(3)	–0.005(2)	–0.002(2)	–0.008(3)
C(16)	4*e*	–0.1362(4)	0.2800(3)	0.4379(2)	0.036(3)	0.028(3)	0.034(3)	0.002(2)	–0.001(2)	0.004(2)
O(1)	4*e*	0.1206(3)	0.0756(2)	0.4014(1)	0.052(2)	0.031(2)	0.035(2)	–0.016(2)	0.004(2)	–0.000(2)
C(30)	4*e*	0.0312(5)	–0.2303(3)	0.3257(2)	0.048(3)	0.031(3)	0.027(3)	0.003(2)	0.002(2)	–0.003(2)
C(9)	4*e*	0.1178(5)	0.1055(4)	0.3010(2)	0.053(3)	0.035(3)	0.028(3)	–0.004(3)	0.004(2)	0.009(2)
C(21)	4*e*	–0.1124(4)	0.3623(4)	0.4549(2)	0.045(3)	0.023(3)	0.044(3)	0.002(2)	–0.002(3)	0.001(2)
O(4)	4*e*	–0.1491(4)	0.1274(2)	0.4486(1)	0.067(2)	0.022(2)	0.038(2)	0.005(2)	0.001(2)	0.000(2)
C(38)	4*e*	–0.3707(6)	–0.2684(4)	0.3408(2)	0.068(4)	0.044(4)	0.044(4)	–0.009(3)	0.008(3)	–0.004(3)
C(1)	4*e*	0.1410(4)	0.1439(3)	0.4232(2)	0.035(3)	0.036(3)	0.023(3)	0.004(2)	0.001(2)	–0.002(2)
C(4)	4*e*	0.1725(6)	0.3809(4)	0.3976(2)	0.078(5)	0.024(3)	0.061(4)	–0.005(3)	0.004(3)	–0.001(3)
O(10)	4*e*	–0.0918(3)	–0.1611(3)	0.3767(1)	0.055(2)	0.046(2)	0.033(2)	–0.005(2)	0.011(2)	–0.014(2)
C(29)	4*e*	0.0008(5)	–0.1548(4)	0.3551(2)	0.045(3)	0.032(3)	0.030(3)	0.004(3)	–0.004(2)	–0.002(2)
C(47)	4*e*	–0.7024(5)	–0.1482(4)	0.4126(2)	0.038(3)	0.052(4)	0.044(4)	–0.005(3)	–0.004(3)	–0.016(3)
C(48)	4*e*	–0.6308(5)	–0.1937(4)	0.4421(2)	0.045(3)	0.040(4)	0.053(4)	–0.002(3)	0.002(3)	0.008(3)
C(40)	4*e*	–0.4572(5)	–0.1678(4)	0.2894(2)	0.057(4)	0.044(4)	0.053(4)	0.004(3)	–0.002(3)	–0.010(3)
C(36)	4*e*	–0.1609(5)	–0.3063(4)	0.3406(2)	0.060(4)	0.030(3)	0.040(3)	–0.006(3)	0.002(3)	–0.004(3)
C(43)	4*e*	–0.3438(5)	–0.0756(4)	0.4281(2)	0.038(3)	0.037(3)	0.051(4)	–0.002(3)	–0.001(3)	–0.008(3)
C(18)	4*e*	–0.1691(6)	0.3437(5)	0.3657(2)	0.094(5)	0.058(5)	0.039(4)	–0.007(4)	–0.014(3)	0.009(3)
C(11)	4*e*	0.0476(7)	–0.0047(4)	0.2502(2)	0.093(6)	0.037(4)	0.053(4)	–0.013(4)	–0.004(4)	–0.009(3)
O(2)	4*e*	0.1335(4)	0.1433(2)	0.4645(1)	0.075(3)	0.035(2)	0.028(2)	–0.004(2)	0.008(2)	0.002(2)
O(5)	4*e*	–0.1023(3)	0.2086(2)	0.5066(1)	0.054(2)	0.033(2)	0.032(2)	0.002(2)	–0.003(2)	0.002(2)
O(11)	4*e*	0.0639(3)	–0.0902(3)	0.3570(2)	0.045(2)	0.032(2)	0.076(3)	–0.007(2)	0.004(2)	–0.013(2)
C(13)	4*e*	–0.0763(6)	0.1149(5)	0.2685(2)	0.064(4)	0.054(5)	0.067(5)	0.005(4)	–0.009(4)	0.000(4)
O(7)	4*e*	–0.2879(3)	–0.0975(3)	0.4625(2)	0.041(2)	0.066(3)	0.064(3)	–0.001(2)	–0.010(2)	–0.005(2)
O(12)	4*e*	–0.1687(4)	–0.3558(3)	0.3711(2)	0.065(3)	0.054(3)	0.075(3)	–0.003(2)	0.008(2)	0.024(3)
C(41)	4*e*	–0.3527(6)	–0.1559(5)	0.2703(2)	0.070(4)	0.060(5)	0.044(4)	0.003(4)	0.000(3)	0.008(3)
O(8)	4*e*	–0.3003(4)	–0.0310(3)	0.3983(2)	0.042(2)	0.078(4)	0.088(4)	–0.013(2)	–0.002(2)	0.021(3)
C(45)	4*e*	–0.5441(5)	–0.0576(4)	0.3940(2)	0.046(3)	0.038(3)	0.054(4)	–0.002(3)	0.002(3)	0.003(3)
C(15)	4*e*	–0.1281(4)	0.2004(3)	0.4656(2)	0.025(2)	0.025(3)	0.048(3)	0.005(2)	–0.003(2)	–0.001(2)
C(37)	4*e*	–0.2628(5)	–0.2573(4)	0.3219(2)	0.051(3)	0.034(3)	0.038(3)	–0.007(3)	–0.002(3)	–0.005(2)
C(49)	4*e*	–0.5128(5)	–0.1716(4)	0.4475(2)	0.036(3)	0.036(3)	0.043(3)	–0.001(2)	–0.003(2)	–0.005(3)
C(8)	4*e*	0.2152(5)	0.1384(4)	0.3306(2)	0.055(3)	0.035(3)	0.025(3)	–0.005(3)	0.007(2)	0.005(2)
C(17)	4*e*	–0.1643(5)	0.2720(4)	0.3930(2)	0.066(4)	0.035(3)	0.040(3)	–0.004(3)	–0.009(3)	–0.002(3)
C(10)	4*e*	0.1337(6)	0.0289(4)	0.2782(2)	0.070(4)	0.042(4)	0.042(4)	0.002(3)	–0.001(3)	–0.004(3)
C(35)	4*e*	–0.0459(5)	–0.2981(4)	0.3186(2)	0.054(3)	0.030(3)	0.036(3)	0.000(3)	0.008(3)	–0.005(2)
C(3)	4*e*	0.1573(5)	0.3042(3)	0.4204(2)	0.053(3)	0.028(3)	0.041(3)	–0.009(3)	0.002(3)	–0.004(2)
C(7)	4*e*	0.1965(5)	0.2221(4)	0.3550(2)	0.051(3)	0.030(3)	0.033(3)	–0.010(3)	0.000(2)	0.003(2)
C(6)	4*e*	0.2148(6)	0.2999(4)	0.3328(2)	0.093(5)	0.045(4)	0.037(4)	–0.018(4)	0.008(3)	0.005(3)
C(14)	4*e*	0.0130(6)	0.1472(4)	0.2962(2)	0.077(5)	0.040(4)	0.043(4)	0.003(3)	0.001(3)	–0.007(3)
C(46)	4*e*	–0.6612(5)	–0.0794(4)	0.3889(2)	0.046(3)	0.039(4)	0.054(4)	0.009(3)	–0.005(3)	–0.001(3)
C(12)	4*e*	–0.0561(6)	0.0393(5)	0.2461(2)	0.075(5)	0.054(4)	0.039(4)	–0.022(4)	–0.009(3)	0.007(3)
C(31)	4*e*	0.1383(5)	–0.2288(4)	0.3050(2)	0.060(4)	0.041(4)	0.039(3)	–0.003(3)	0.009(3)	0.004(3)

Table 3. Continued.

Atom	Site	x	y	z	U_{11}	U_{22}	U_{33}	U_{12}	U_{13}	U_{23}
C(34)	4*e*	–0.0154(6)	–0.3650(4)	0.2904(2)	0.083(5)	0.037(4)	0.054(4)	–0.004(3)	0.009(4)	–0.016(3)
C(20)	4*e*	–0.1170(6)	0.4336(4)	0.4276(2)	0.079(4)	0.026(3)	0.048(4)	–0.008(3)	–0.003(3)	0.003(3)
C(39)	4*e*	–0.4677(6)	–0.2238(4)	0.3248(2)	0.054(4)	0.054(4)	0.054(4)	–0.007(3)	0.009(3)	–0.008(3)
C(42)	4*e*	–0.2551(6)	–0.2015(4)	0.2866(2)	0.056(4)	0.061(4)	0.048(4)	–0.010(3)	0.008(3)	0.002(3)
C(5)	4*e*	0.2012(7)	0.3782(4)	0.3545(2)	0.112(6)	0.029(4)	0.058(5)	–0.014(4)	0.002(4)	0.010(3)
C(32)	4*e*	0.1680(6)	–0.2954(4)	0.2774(2)	0.068(4)	0.056(4)	0.050(4)	0.006(3)	0.025(3)	–0.005(3)
C(33)	4*e*	0.0894(7)	–0.3626(5)	0.2691(2)	0.093(5)	0.049(4)	0.052(4)	0.005(4)	0.015(4)	–0.021(3)
C(19)	4*e*	–0.1456(7)	0.4251(4)	0.3833(2)	0.100(6)	0.038(4)	0.058(5)	–0.003(4)	–0.011(4)	0.021(3)
O(6)	4*e*	0.0292(4)	0.3784(3)	0.5134(2)	0.054(3)	0.054(3)	0.059(3)	–0.003(2)	–0.012(2)	–0.016(2)
O(9)	4*e*	–0.3630(4)	–0.2748(3)	0.4615(2)	0.083(3)	0.063(3)	0.083(4)	0.030(3)	0.007(3)	0.006(3)
C(22)	4*e*	–0.0744(6)	0.3765(3)	0.5029(2)	0.064(4)	0.018(3)	0.046(4)	0.000(3)	–0.008(3)	–0.003(2)
C(23)	4*e*	–0.1662(5)	0.3912(3)	0.5357(2)	0.061(4)	0.019(3)	0.051(4)	0.001(3)	0.004(3)	0.005(2)
C(50)	4*e*	–0.4411(5)	–0.2303(4)	0.4767(2)	0.050(4)	0.036(4)	0.071(5)	0.000(3)	–0.008(3)	0.002(3)
C(24)	4*e*	–0.2785(6)	0.4148(4)	0.5228(2)	0.066(4)	0.043(4)	0.057(4)	–0.003(3)	0.008(3)	–0.001(3)
C(51)	4*e*	–0.4704(5)	–0.2365(4)	0.5240(2)	0.045(3)	0.047(4)	0.053(4)	–0.004(3)	–0.009(3)	0.008(3)
C(28)	4*e*	–0.1355(7)	0.3822(4)	0.5802(2)	0.098(5)	0.026(3)	0.046(4)	–0.001(3)	0.010(4)	0.004(3)
C(52)	4*e*	–0.5242(6)	–0.1694(5)	0.5445(2)	0.075(5)	0.055(4)	0.061(5)	–0.006(4)	–0.001(4)	0.003(4)
C(26)	4*e*	–0.3271(8)	0.4182(4)	0.5979(3)	0.108(6)	0.030(4)	0.075(6)	–0.021(4)	0.043(5)	–0.007(4)
C(27)	4*e*	–0.2182(8)	0.3938(4)	0.6110(2)	0.126(7)	0.034(4)	0.048(4)	–0.007(4)	0.020(4)	0.004(3)
C(56)	4*e*	–0.4442(7)	–0.3114(5)	0.5471(3)	0.075(5)	0.056(5)	0.081(6)	–0.003(4)	–0.018(4)	0.021(4)
C(54)	4*e*	–0.5202(7)	–0.2505(7)	0.6113(3)	0.069(5)	0.101(7)	0.054(5)	–0.028(5)	–0.014(4)	0.018(5)
C(25)	4*e*	–0.3600(7)	0.4297(5)	0.5544(3)	0.067(5)	0.050(5)	0.106(7)	–0.012(4)	0.021(4)	–0.015(5)
C(53)	4*e*	–0.5483(6)	–0.1754(6)	0.5892(3)	0.074(5)	0.081(6)	0.067(5)	–0.010(4)	0.000(4)	–0.002(4)
C(55)	4*e*	–0.4716(7)	–0.3180(6)	0.5910(3)	0.089(6)	0.082(7)	0.082(6)	–0.008(5)	–0.018(5)	0.046(5)
Cl(2)	4*e*	–0.4314(3)	0.4384(2)	0.63715(9)	0.162(2)	0.079(2)	0.132(2)	–0.036(2)	0.099(2)	–0.027(2)
Cl(4)	4*e*	–0.5483(2)	–0.2572(2)	0.66757(7)	0.117(2)	0.179(3)	0.060(1)	–0.049(2)	–0.011(1)	0.028(2)

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References

1. Moulton, B.; Zaworotko, M. J.: From Molecules to Crystal Engineering: Supramolecular Isomerism and Polymorphism in Network Solids. Chem. Rev. **101** (2001) 1629-1658.
2. Eddaoudi, M.; Moler, D. B.; Li, L. H.; Chen, B. L.; Reineke, T. M.; O'Keeffe, M.; Yaghi, O. M.: Modular Chemistry: Secondary Building Units as a Basis for the Design of Highly Porous and Robust Metal-Organic Carboxylate Frameworks. Acc. Chem. Res. **34** (2001) 319-330.
3. Sun, D. F.; Cao, R.; Liang, Y. C.; Shi, Q.; Su, W. P.; Hong, M. C.: Hydrothermal syntheses, structures and properties of terephthalate-bridged polymeric complexes with zig-zag chain and channel structures. Chem. Soc., Dalton Trans. (2001) 2335-2340.
4. Kobel, W.; Hanack, M.: Bisaxially coordinated (phthalocyaninato)ruthenium(II) compounds. Inorg. Chem. **25** (1986) 103-107.
5. Eddaoudi, M.; Kim, J.; Rosi, N.; Vodak, D.; Wachter, J.; O'Keeffe, M.; Yaghi, O. M.: Systematic Design of Pore Size and Functionality in Isoreticular MOFs and Their Application in Methane Storage. Science. **295** (2002) 469-472.
6. Noro, S. I.; Kitagawa, S.; Kondo, M.; Seki, K.: A New, Methane Adsorbent, Porous Coordination Polymer [{$CuSiF_6$(4,4′-bipyridine)$_2$}$_n$]. Angew. Chem. Int. Ed. **39** (2000) 2081-2084.
7. Chen, B. L.; Eddaoudi, M.; Hyde, S. T.; O'Keeffe, M.; Yaghi, O. M.: Interwoven Metal-Organic Framework on a Periodic Minimal Surface with Extra-Large Pores. Science **291** (2001) 1021-1023.
8. Seo, J. S.; Whang, D.; Lee, H.; Jun, S. I.; Oh, J.; Jeon, Y. J.; Kim, K.: A homochiral metal-organic porous material for enantioselective separation and catalysis. Nature **404** (2000) 982-986.
9. Wang, Q. W.; Li, X. M.; Meng, Q. L.; Liu, B.; Gao, G. G.: Synthesis and Crystal Structure of a Manganese(II) Complex with 2-(4′-Chlorinebenzoyl)-benzoic Acid and 1,10-Phenanthroline. Chinese J. Struct. Chem. **3** (2009) 335-337.
10. Li, X. M.; Wang, Q. W.; Liu, B.; Wang, Z. T.: Hydrothermal Synthesis and Crystal Structure of a Ni(II) Complex Assembled by 2-(4′-Chlorinebenzoyl)-benzoic Acid and 1,10-Phenanthroline. Chinese J. Inorg. Chem. **10** (2010) 1904-1907.
11. Sheldrick, G. M.: A short history of SHELX. Acta Crystallogr. **A64** (2008) 112-122.