Supplementary information

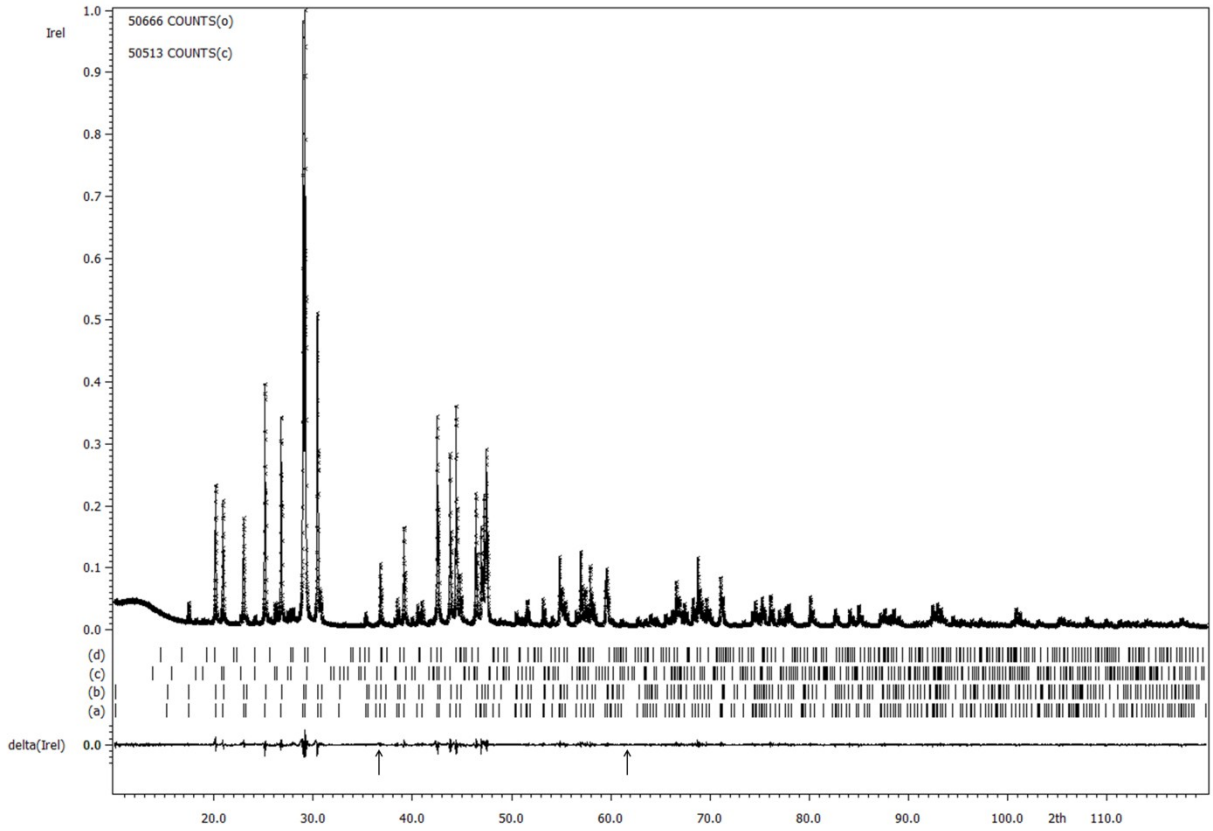


Fig. S1. X-ray powder diffraction patterns of **1**. Observed (crosses), calculated (solid line) and difference (solid line below) plots. Positions of Bragg reflections are shown as strokes underneath: (a) $CuK_{\alpha1}$, (b) $CuK_{\alpha2}$, (c) $CuK_{\beta1}$, and (d) $WL_{\alpha1}$ emission lines. Arrows at the difference plot point to the reflections of the CoO phase impurity.

Table S1. Atomic parameters and thermal displacement parameters ($Å^2$) for **1**. $R_{wp} = 0.047$, $R_{all} = 0.013$.

Atom	Ba(1)	Ba(2)	P	O(1)	O(2)	O(3)	O(4), F	Co
Site	4f	6h	6h	6h	6h	12i	4e	12i
SOF	1	1	1	1	1	1	0.3, 0.2	0.0112(11)
x	1/3	0.24148(12)	0.4009(5)	0.3389(11)	0.5768(11)	0.3436(6)	0	0.039(10)
y	2/3	0.98073(12)	0.3687(5)	0.4810(10)	0.4580(11)	0.2636(6)	0	0
z	-0.0005(2)	1/4	1/4	1/4	1/4	0.0888(7)	0.199(3)	0
U_{eq}, U_{iso}	0.0218(5)	0.0230(8)	0.0186(14)	0.020(3)	0.023(3)	0.023(2)	0.048(7)	0.023
U_{11}	0.0233(7)	0.0243(10)						
U_{22}	0.0233(7)	0.0188(9)						
U_{33}	0.0188(8)	0.0233(8)						
U_{12}	0.0117(3)	0.0088(9)						
U_{13}	0	0						
U_{23}	0	0						

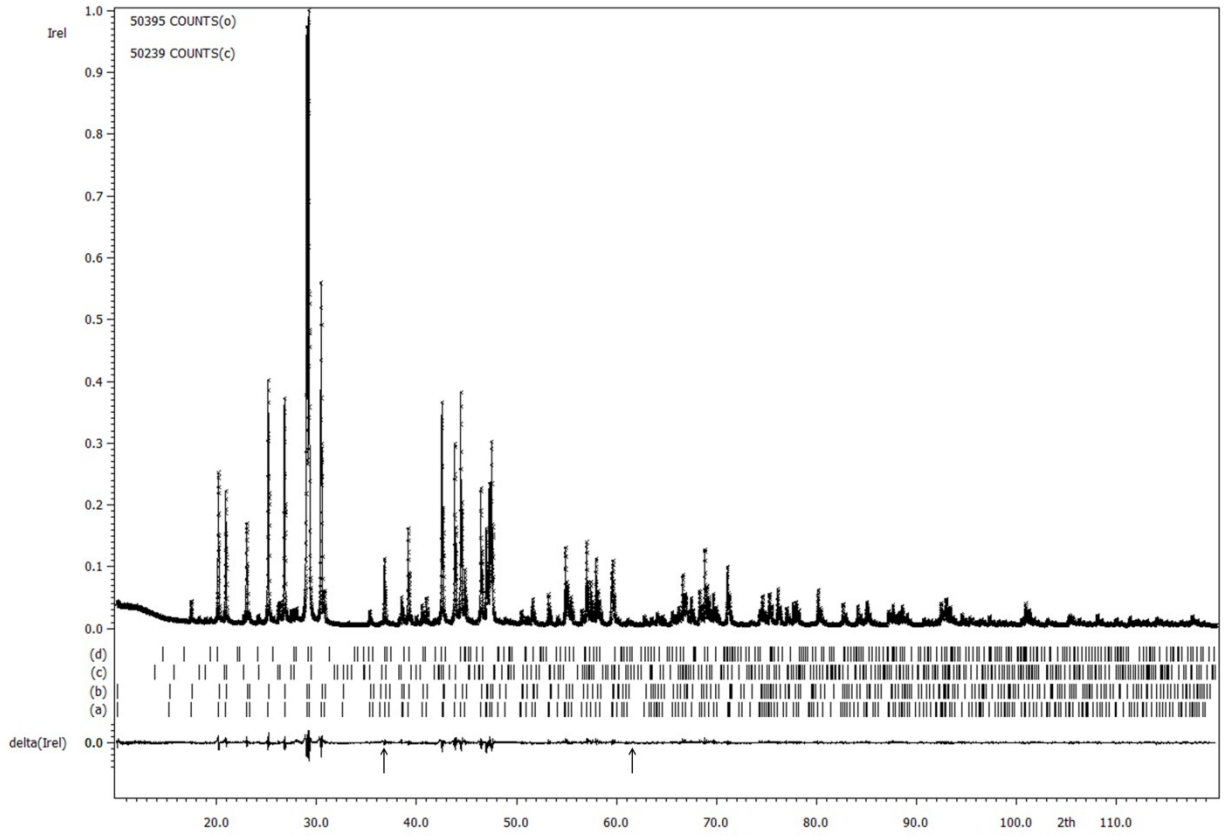


Fig. S2. X-ray powder diffraction patterns of **2**. Observed (crosses), calculated (solid line) and difference (solid line below) plots. Positions of Bragg reflections are shown as strokes underneath: (a) $CuK_{\alpha1}$, (b) $CuK_{\alpha2}$, (c) $CuK_{\beta1}$, and (d) $WL_{\alpha1}$ emission lines. Arrows at the difference plot point to the reflections of the CoO phase impurity.

Table S2. Atomic parameters and thermal displacement parameters ($Å^2$) for **2**. $R_{wp} = 0.056$, $R_{all} = 0.019$.

Atom	Ba(1)	Ba(2)	P	O(1)	O(2)	O(3)	O(4), F	Co
Site	4f	6h	6h	6h	6h	12i	4e	12i
SOF	1	1	1	1	1	1	0.2, 0.3	0.0105(18)
x	1/3	0.24119(18)	0.4006(7)	0.3406(18)	0.5806(17)	0.3410(10)	0	0.045(14)
y	2/3	0.98075(18)	0.3699(8)	0.4823(15)	0.4599(16)	0.2619(10)	0	0
z	-0.0008(3)	1/4	1/4	1/4	1/4	0.0891(10)	0.197(3)	0
U_{eq}, U_{iso}	0.0201(8)	0.0212(11)	0.0162(19)	0.029(5)	0.023(5)	0.025(3)	0.038(10)	0.023
U_{11}	0.0214(10)	0.0214(15)						
U_{22}	0.0214(10)	0.0170(13)						
U_{33}	0.0177(12)	0.0221(11)						
U_{12}	0.0107(5)	0.0074(12)						
U_{13}	0	0						
U_{23}	0	0						

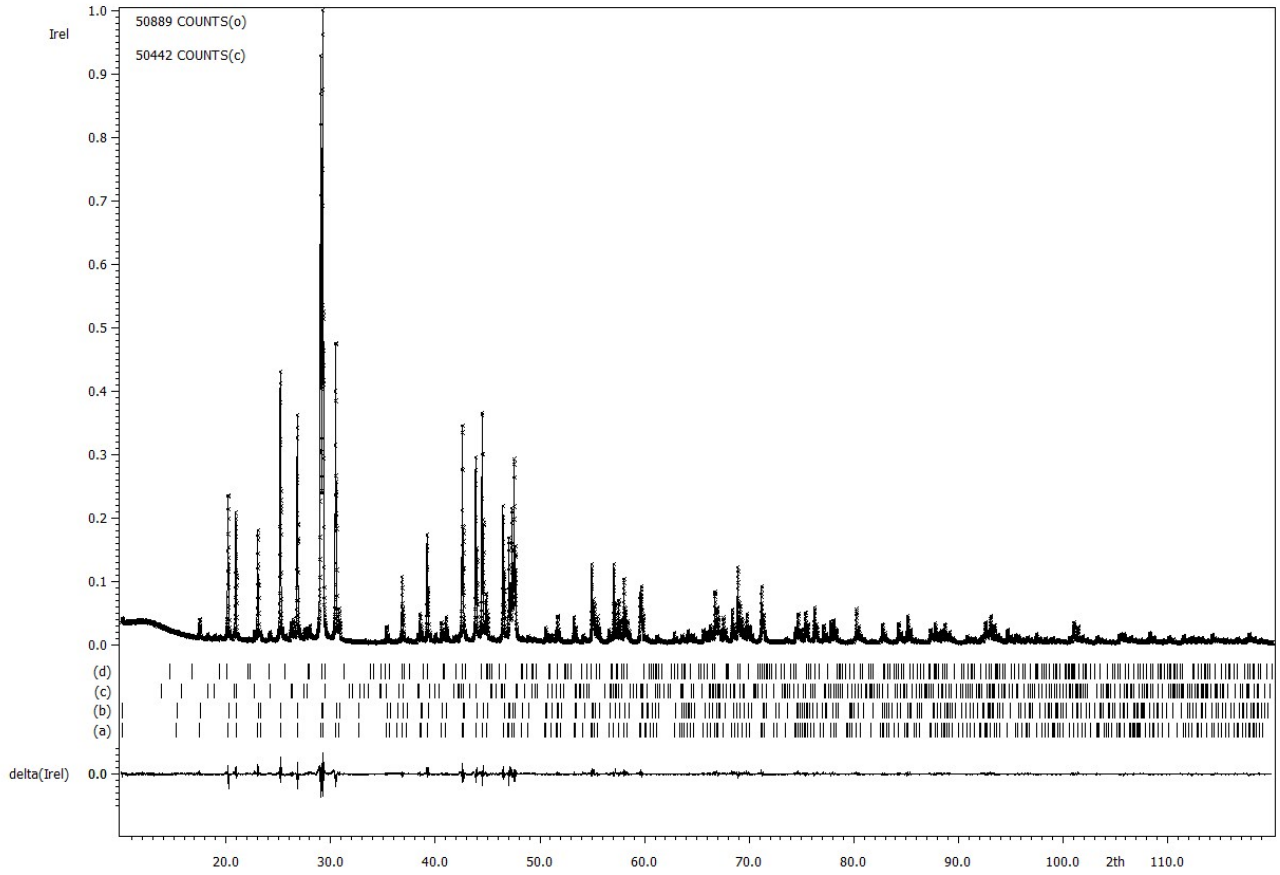


Fig. S3. X-ray powder diffraction patterns of **3**. Observed (crosses), calculated (solid line) and difference (solid line below) plots. Positions of Bragg reflections are shown as strokes underneath: (a) $CuK_{\alpha1}$, (b) $CuK_{\alpha2}$, (c) $CuK_{\beta1}$, and (d) $WL_{\alpha1}$ emission lines.

Table S3. Atomic parameters and thermal displacement parameters (Å^2) for **3**. R_{wp} = 0.064, R_{all} = 0.020.

Atom	Ba(1)	Ba(2)	P	O(1)	O(2)	O(3)	O(4), F
Site	4f	6h	6h	6h	6h	12i	4e
SOF	1	1	1	1	1	1	0.04, 0.45
x	1/3	0.23972(18)	0.4030(7)	0.3392(17)	0.5824(16)	0.3458(10)	0
y	2/3	0.98078(18)	0.3710(7)	0.4836(15)	0.4634(16)	0.2637(10)	0
z	-0.0010(3)	1/4	1/4	1/4	1/4	0.0898(10)	0.212(5)
U_{eq}, U_{iso}	0.0195(7)	0.0193(11)	0.0152(19)	0.024(5)	0.018(5)	0.025(3)	0.040(11)
U_{11}	0.0217(9)	0.0214(14)					
U_{22}	0.0217(9)	0.0188(13)					
U_{33}	0.0150(11)	0.0163(10)					
U_{12}	0.0109(5)	0.0091(12)					
U_{13}	0	0					
U_{23}	0	0					

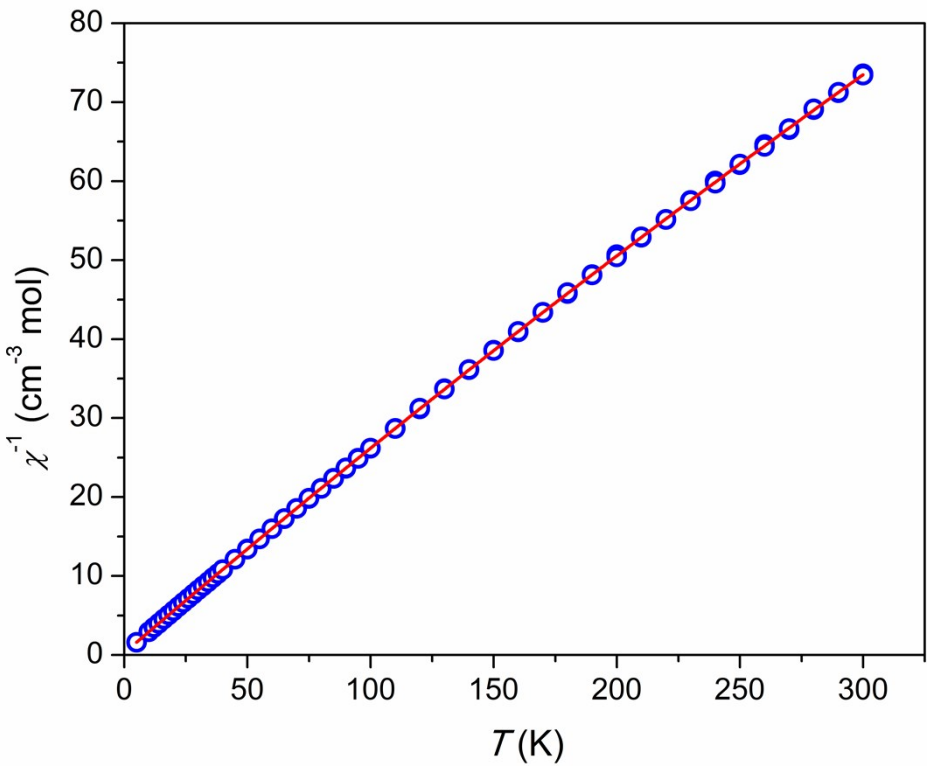
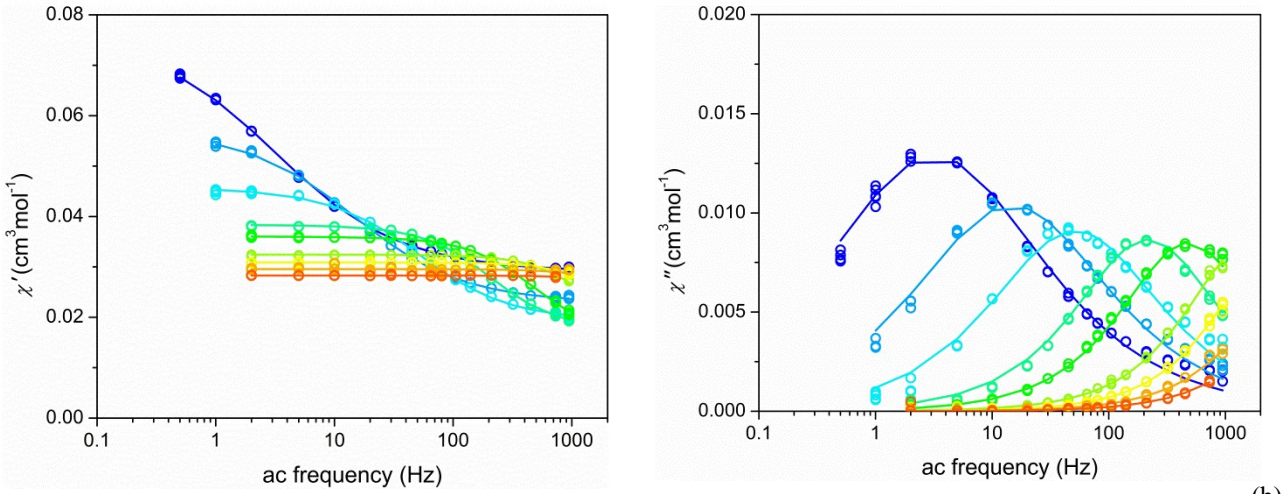
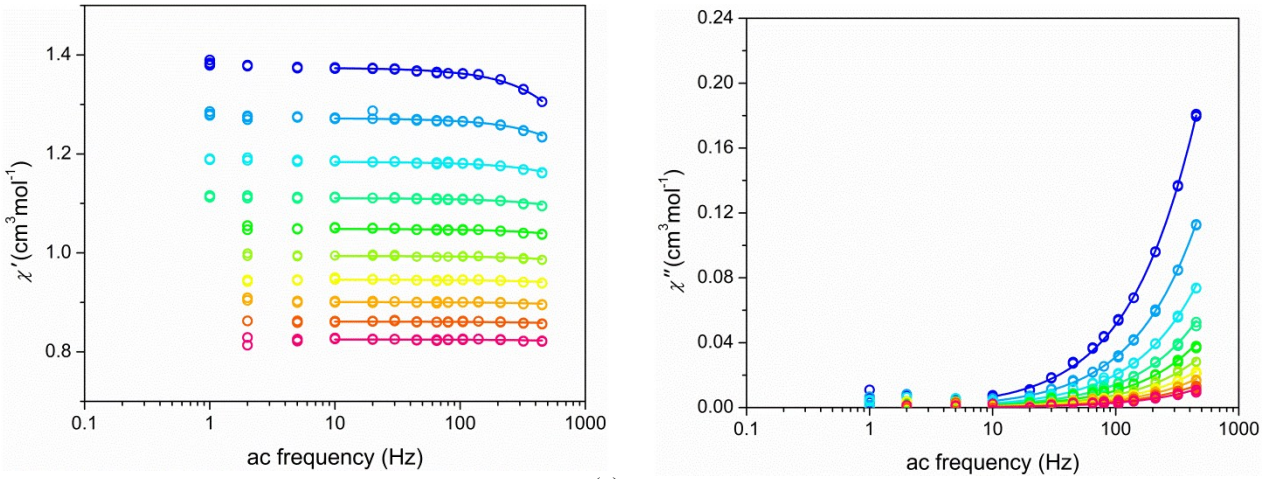


Fig. S4. Temperature dependence of the inversed susceptibility of **3** under a field of 1 kOe.



(a) (b)

Figure S5. Frequency (f) dependence of ac susceptibility per mol of Co under a zero magnetic field for **1**. (a) – in-phase susceptibility χ', (b) – out-of-phase susceptibility χ''. Symbols – experimental points, lines – fitting. The measurement temperature color designation – from blue to orange – 15, 20, 25, 30, 32.5, 36, 38, 40, 42 K.



(a) (b)

Figure S6. Frequency (f) dependence of ac susceptibility per mol of Co under a zero magnetic field for **3**. (a) – in-phase susceptibility χ', (b) – out-of-phase susceptibility χ''. Symbols – experimental points, lines – fitting. The measurement temperature color designation – from blue to carmine-red – 1.8, 2.0, 2.2, 2.4, 2.6, 2.8, 3.0, 3.2, 3.4, 3.6 K.