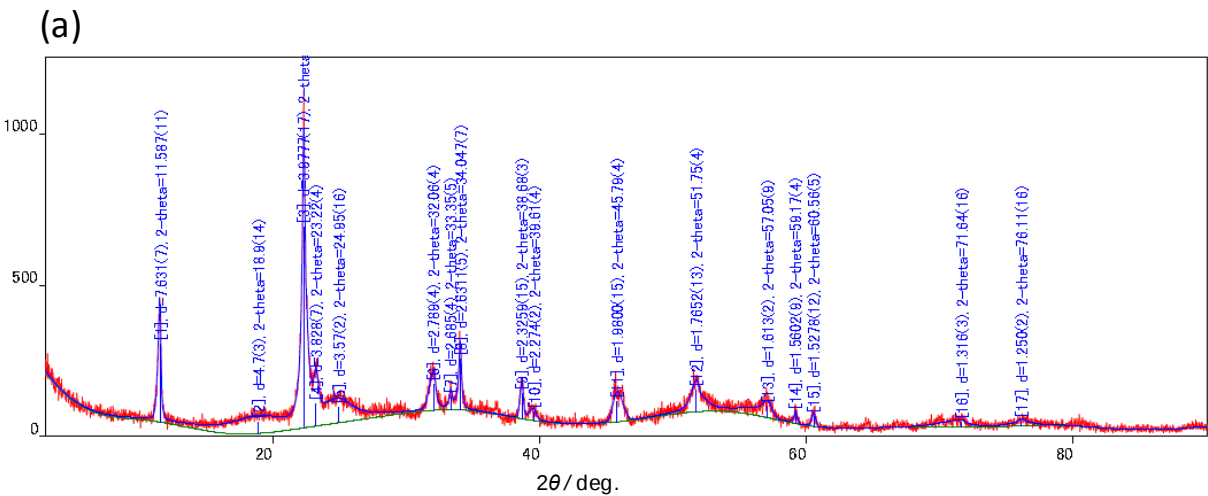


Supplementary Information

In-Ga-Zn oxide nanoparticles acting as oxide semiconductor material
synthesized via coprecipitation-based method

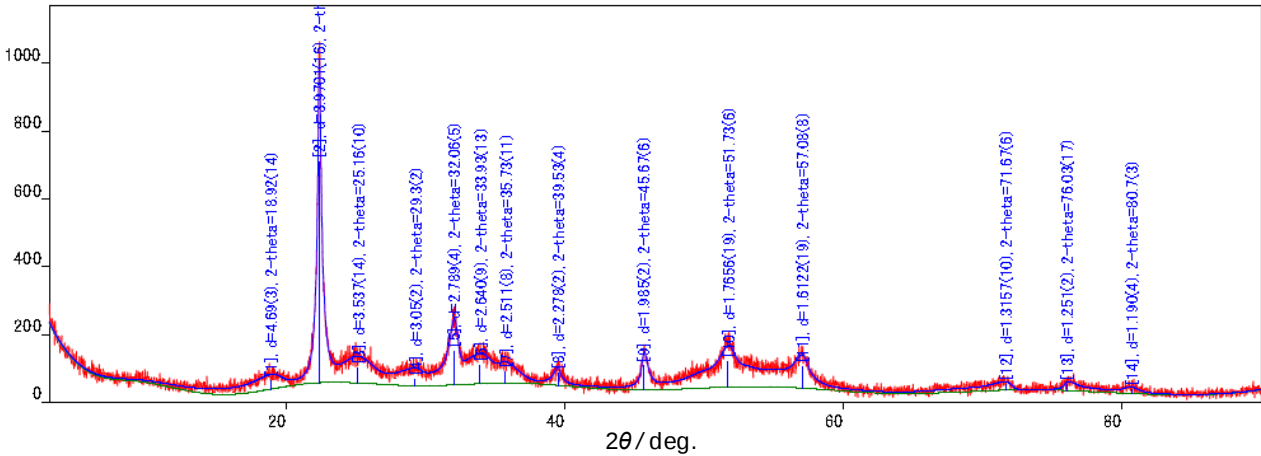
Nobuko Fukuda*, Yuichi Watanabe, Sei Uemura, Yuji Yoshida, Takashi Nakamura, and Hirobumi Ushijima

Fig. S1. Results of the identification of the crystalline phases on the basis of XRD patterns of the IGZO precursor nanoparticles before (a) and after sintering at 200 °C (b), 700 °C (c), and 1000 °C (d).



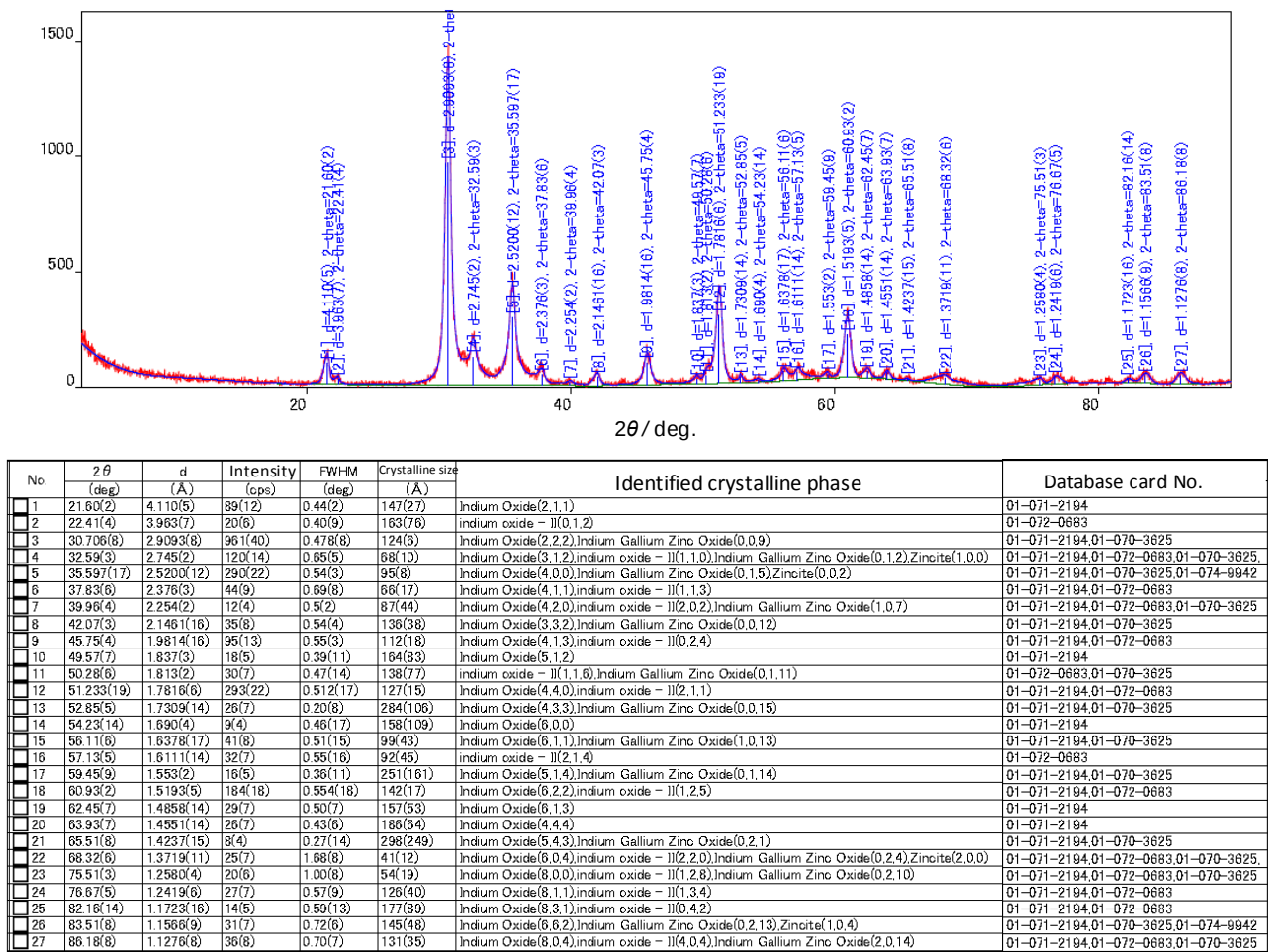
No.	2θ (deg)	d (Å)	Intensity (cps)	FWHM (deg)	Crystalline size (Å)	Identified crystalline phase	Database No.
1	11.587(11)	7.631(7)	257(21)	0.266(12)	247(29)	Zink gallium carbonate(0,0,3)	01-076-3644
2	18.9(14)	4.7(3)	38(8)	4.7(2)	12(35)	Dzhalindite, syn(1,1,0)	01-076-1464
3	22.332(9)	3.9777(17)	664(33)	0.274(15)	167(14)	Dzhalindite, syn(2,0,0)	01-076-1464
4	23.22(4)	3.828(7)	75(11)	0.40(6)	151(60)	Zink gallium carbonate(0,0,6)	01-076-3644
5	24.95(16)	3.57(2)	51(9)	3.1(5)	21(13)	Dzhalindite, syn(2,1,1)	01-076-1464
6	32.06(4)	2.789(4)	85(12)	0.55(4)	131(26)	Dzhalindite, syn(2,2,0)	01-076-1464
7	33.35(5)	2.685(4)	42(8)	0.23(7)	244(116)	Zink gallium carbonate(1,0,1)	01-076-3644
8	34.047(7)	2.6311(5)	167(17)	0.20(3)	271(46)	Zink gallium carbonate(0,1,2)	01-076-3644
9	38.68(3)	2.3259(15)	84(12)	0.28(2)	288(58)	Zink gallium carbonate(0,1,5)	01-076-3644
10	39.61(4)	2.274(2)	27(7)	0.58(9)	123(83)	Dzhalindite, syn(2,2,2)	01-076-1464
11	45.79(4)	1.9800(15)	67(11)	0.83(3)	102(20)	Dzhalindite, syn(4,0,0),Zink gallium carbonate(0,1,8)	01-076-1464,01-076-3644
12	51.75(4)	1.7652(13)	71(11)	0.81(7)	66(17)	Dzhalindite, syn(4,2,0),Zink gallium carbonate(1,0,10)	01-076-1464,01-076-3644
13	57.05(9)	1.613(2)	37(8)	1.13(17)	46(21)	Dzhalindite, syn(4,2,2)	01-076-1464
14	59.17(4)	1.5602(9)	34(8)	0.19(6)	317(140)	Dzhalindite, syn(5,0,1),Zink gallium carbonate(1,1,0)	01-076-1464,01-076-3644
15	60.56(5)	1.5278(12)	34(8)	0.29(5)	310(136)	Zink gallium carbonate(1,1,3)	01-076-3644
16	71.64(16)	1.316(3)	16(5)	2.3(3)	36(22)	Dzhalindite, syn(4,4,2),Zink gallium carbonate(0,2,1)	01-076-1464,01-076-3644
17	76.11(16)	1.250(2)	16(5)	0.9(4)	56(39)	Dzhalindite, syn(6,2,0),Zink gallium carbonate(0,2,7)	01-076-1464,01-076-3644

(b)

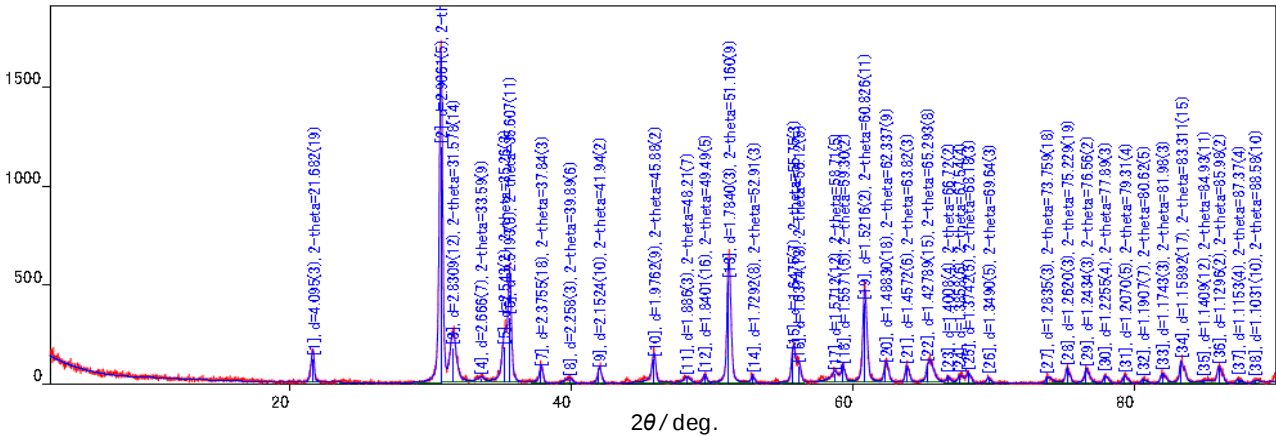


No.	2 θ (deg)	d (Å)	intensity (cps)	FWHM (deg)	Crystalline size (Å)	Identified crystalline phase	Database card No.
1	18.92(14)	4.69(3)	25(6)	3.1(4)	15(6)	Unknown	0
2	22.375(9)	3.9701(16)	852(33)	0.309(14)	153(10)	Dzhalindite, syn(2,0,0)	01-078-1464
3	25.16(10)	3.537(14)	44(9)	2.41(17)	33(10)	Unknown	0
4	29.3(2)	3.05(2)	19(6)	2.2(3)	35(82)	Dzhalindite, syn(2,1,1)	01-078-1464
5	32.06(5)	2.789(4)	100(13)	0.70(4)	93(33)	Dzhalindite, syn(2,2,0)	01-078-1464
6	33.93(13)	2.640(9)	54(10)	3.0(12)	17(13)	Unknown	0
7	35.73(11)	2.511(8)	34(8)	1.7(3)	40(22)	Dzhalindite, syn(3,0,1)	01-078-1464
8	39.53(4)	2.278(2)	35(8)	0.57(10)	89(36)	Dzhalindite, syn(2,2,2)	01-078-1464
9	45.67(6)	1.985(2)	71(11)	0.52(6)	108(24)	Dzhalindite, syn(4,0,0)	01-078-1464
10	51.73(6)	1.7656(19)	76(11)	1.96(15)	22(6)	Dzhalindite, syn(4,2,0)	01-078-1464
11	57.08(8)	1.6122(19)	62(10)	1.60(18)	29(9)	Dzhalindite, syn(4,2,2)	01-078-1464
12	71.67(6)	1.3157(10)	16(5)	2.4(4)	22(12)	Dzhalindite, syn(4,4,2)	01-078-1464
13	76.03(17)	1.251(2)	18(6)	1.3(4)	43(23)	Dzhalindite, syn(6,2,0)	01-078-1464
14	80.7(3)	1.190(4)	12(4)	1.2(3)	58(44)	Dzhalindite, syn(6,2,2)	01-078-1464

(c)



(d)



No.	2 θ (deg)	d (Å)	Intensity (cps)	FWHM (deg)	Crystalline size (Å)	Identified crystalline phase	Database card No.
1	21.682(19)	4.095(3)	110(14)	0.258(15)	286(47)	Indium Oxide(2,1,1)	00-006-0416
2	30.741(5)	2.906(15)	1188(44)	0.241(4)	288(14)	Indium Oxide(2,2,2)	00-006-0416
3	31.578(14)	2.8309(12)	167(17)	0.478(16)	148(18)	Indium gallium trioxide bis(zinc oxide)(1,0,0)	01-078-8139
4	33.59(9)	2.666(7)	14(5)	0.45(8)	179(98)	Indium Oxide(3,2,1)Indium gallium trioxide bis(zinc oxide)(1,0,3)	00-006-0416,01-078-8139
5	35.26(3)	2.543(2)	168(17)	0.584(19)	129(19)	Indium gallium trioxide bis(zinc oxide)(1,0,4)	01-078-8139
6	35.807(11)	2.5193(8)	321(23)	0.194(11)	379(58)	Indium Oxide(4,0,0)	00-006-0416
7	37.84(3)	2.3755(18)	82(10)	0.25(3)	271(57)	Indium Oxide(4,1,1)	00-006-0416
8	39.89(6)	2.258(3)	18(5)	0.63(4)	131(50)	Indium Oxide(4,2,0)Indium gallium trioxide bis(zinc oxide)(1,0,6)	00-006-0416,01-078-8139
9	41.94(2)	2.1524(10)	61(10)	0.25(3)	276(61)	Indium Oxide(3,3,2)	00-006-0416
10	45.88(2)	1.9762(9)	112(14)	0.27(2)	242(40)	Indium Oxide(4,3,1)	00-006-0416
11	48.21(7)	1.886(3)	18(6)	0.53(5)	182(67)	Indium gallium trioxide bis(zinc oxide)(1,0,9)	01-078-8139
12	49.49(5)	1.8401(18)	32(7)	0.25(3)	347(114)	Indium Oxide(5,2,1)	00-006-0416
13	51.180(9)	1.7840(3)	510(28)	0.249(7)	288(20)	Indium Oxide(4,4,0)	00-006-0416
14	52.91(3)	1.7292(8)	34(7)	0.19(4)	386(125)	Indium Oxide(4,3,3)	00-006-0416
15	55.75(3)	1.6475(7)	144(15)	0.28(4)	324(110)	Indium gallium trioxide bis(zinc oxide)(1,1,0)	01-078-8139
16	58.12(5)	1.6374(13)	76(11)	0.32(13)	262(133)	Indium Oxide(6,1,1)Indium gallium trioxide bis(zinc oxide)(1,1,2)	00-006-0416,01-078-8139
17	58.71(5)	1.5712(12)	36(8)	0.39(12)	149(57)	Indium gallium trioxide bis(zinc oxide)(1,0,12)	01-078-8139
18	59.30(2)	1.5571(5)	72(11)	0.22(4)	267(81)	Indium Oxide(5,4,1)	00-006-0416
19	60.828(11)	1.5216(2)	394(26)	0.250(10)	301(24)	Indium Oxide(6,2,2)	00-006-0416
20	62.337(9)	1.48830(18)	78(11)	0.29(2)	307(64)	Indium Oxide(6,3,1)Indium gallium trioxide bis(zinc oxide)(1,0,13)	00-006-0416,01-078-8139
21	63.82(3)	1.4572(6)	71(11)	0.25(3)	365(80)	Indium Oxide(4,4,4)	00-006-0416
22	65.293(8)	1.42789(15)	84(12)	0.476(19)	172(30)	Indium Oxide(5,4,3)Indium gallium trioxide bis(zinc oxide)(2,0,0)	00-006-0416,01-078-8139
23	66.72(2)	1.4008(4)	28(7)	0.17(3)	443(157)	Indium Oxide(6,4,0)Indium gallium trioxide bis(zinc oxide)(2,0,3)	00-006-0416,01-078-8139
24	67.54(4)	1.3858(6)	28(7)	0.32(8)	242(106)	Indium gallium trioxide bis(zinc oxide)(2,0,4)	01-078-8139
25	68.18(3)	1.3742(5)	45(9)	0.25(5)	286(99)	Indium Oxide(7,2,1)	00-006-0416
26	69.64(3)	1.3490(5)	26(7)	0.19(4)	442(164)	Indium Oxide(6,4,2)	00-006-0416
27	73.759(18)	1.2835(3)	28(7)	0.32(4)	185(56)	Indium Oxide(8,5,1)	00-006-0416
28	75.229(18)	1.2620(3)	70(11)	0.23(2)	329(65)	Indium Oxide(8,0,0)	00-006-0416
29	76.56(2)	1.2434(3)	66(10)	0.25(3)	271(53)	Indium Oxide(7,4,1)Indium gallium trioxide bis(zinc oxide)(2,0,9)	00-006-0416,01-078-8139
30	77.89(3)	1.2255(4)	36(8)	0.25(3)	351(100)	Indium Oxide(8,2,0)	00-006-0416
31	79.31(4)	1.2070(5)	31(7)	0.30(4)	330(103)	Indium Oxide(8,5,3)Indium gallium trioxide bis(zinc oxide)(2,0,10)	00-006-0416,01-078-8139
32	80.82(5)	1.1907(7)	15(5)	0.25(6)	410(215)	Indium Oxide(8,2,2)	00-006-0416
33	81.98(3)	1.1743(3)	42(6)	0.28(3)	361(99)	Indium Oxide(8,3,1)Indium gallium trioxide bis(zinc oxide)(2,0,11)	00-006-0416,01-078-8139
34	83.311(15)	1.15892(17)	102(13)	0.257(17)	327(52)	Indium Oxide(8,6,2)	00-006-0416
35	84.93(11)	1.1408(12)	9(4)	0.6(2)	174(125)	Indium Oxide(7,5,2)Indium gallium trioxide bis(zinc oxide)(2,0,12)	00-006-0416,01-078-8139
36	85.98(2)	1.1298(2)	76(11)	0.29(2)	331(77)	Indium Oxide(8,4,0)Indium gallium trioxide bis(zinc oxide)(0,0,20)	00-006-0416,01-078-8139
37	87.37(4)	1.1153(4)	18(6)	0.22(3)	491(233)	Indium Oxide(8,3,3)	00-006-0416
38	88.58(10)	1.1031(10)	12(4)	0.31(10)	349(224)	Indium Oxide(8,4,2)Indium gallium trioxide bis(zinc oxide)(2,0,13)	00-006-0416,01-078-8139

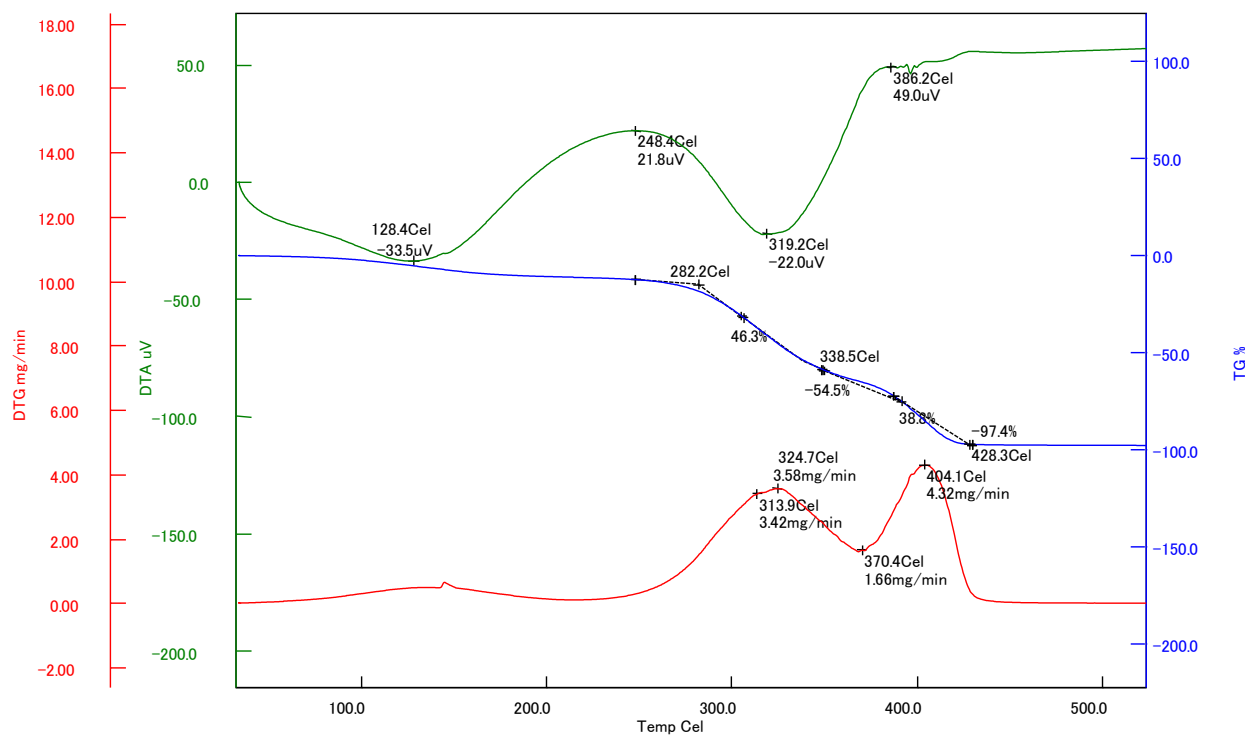


Fig. S2. TG-DTA curves of PEG(COOH)₂. The heating rate is 20 °C min⁻¹.

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