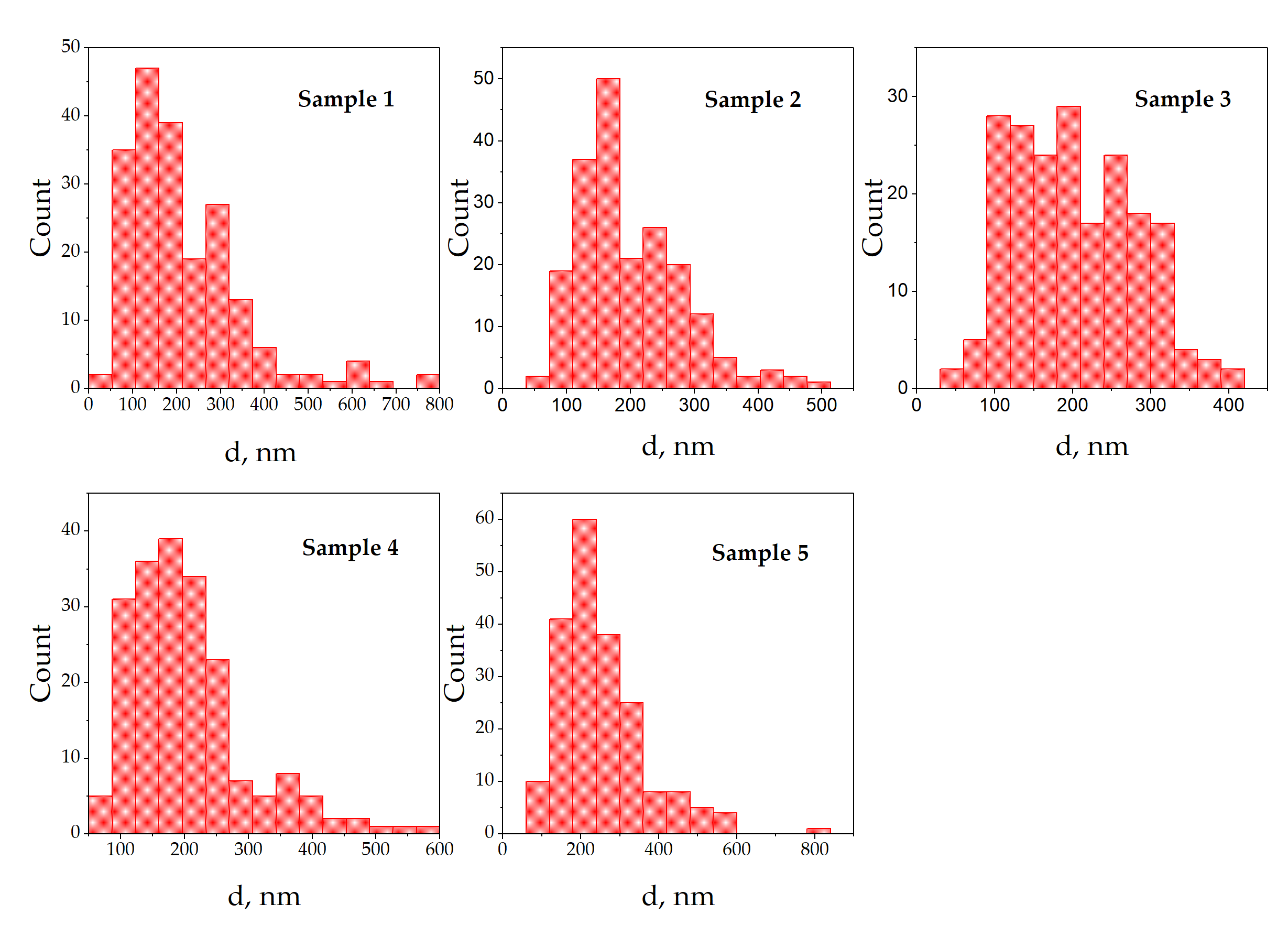
Supplementary for «Novel fluoride matrix for dual-range optical sensors and visualization» A.A. Alexandrov, L.A. Petrova, D.V. Pominova, I.D. Romanishkin, M.V. Tsygankova, S.V. Kuznetsov, V.K. Ivanov, P.P. Fedorov



**Figure S1**. Histogram of particle size distribution.

**Table S1**. XRD data of Sample 1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase name | Ba0.51(1)Gd0.45(1)Na0.04(2)F2.41 | | | | |
| R-Bragg | 1.488 | | | | |
| Spacegroup | *I4* | | | | |
| Mol. Mass, g/mol | 187.52 | | | | |
| Z | 2 | | | | |
| Dx, g/cm3 | 6.039 | | | | |
| a, Å | 4.16395(40) | | | | |
| c, Å | 5.94561(55) | | | | |
| Cell Volume (Å3) | 103.088(22) | | | | |
| d | 2Θ | h | k | l | I% |
| 3.4107 | 26.105 | 0 | 1 | 1 | 85 |
| 2.9728 | 30.035 | 0 | 0 | 2 | 20 |
| 2.9444 | 30.332 | 1 | 1 | 0 | 27 |
| 2.0920 | 43.212 | 1 | 1 | 2 | 100 |
| 2.0820 | 43.429 | 0 | 2 | 0 | 37 |
| 1.7895 | 50.992 | 0 | 1 | 3 | 77 |
| 1.7771 | 51.376 | 1 | 2 | 1 | 0 |
| 1.7771 | 51.376 | 2 | 1 | 1 | 0 |
| 1.7054 | 53.705 | 0 | 2 | 2 | 31 |
| 1.4864 | 62.427 | 0 | 0 | 4 | 18 |
| 1.4722 | 63.099 | 2 | 2 | 0 | 20 |
| 1.3571 | 69.167 | 1 | 2 | 3 | 0 |
| 1.3571 | 69.167 | 2 | 1 | 3 | 0 |
| 1.3516 | 69.486 | 0 | 3 | 1 | 24 |
| 1.3269 | 70.975 | 1 | 1 | 4 | 23 |
| 1.3193 | 71.448 | 2 | 2 | 2 | 16 |
| 1.3168 | 71.606 | 1 | 3 | 0 | 6 |
| 1.3168 | 71.606 | 3 | 1 | 0 | 6 |
| 1.2097 | 79.100 | 0 | 2 | 4 | 0 |
| 1.2039 | 79.556 | 1 | 3 | 2 | 0 |
| 1.2039 | 79.556 | 3 | 1 | 2 | 0 |

**Table S2**. XRD data of Sample 2.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase name | Ba0.44(1)Gd0.40(1)Ln0.11(1)Na0.05(2)F2.46 | | | | |
| R-Bragg | 5.031 | | | | |
| Spacegroup | *I4* | | | | |
| Mol. Mass, g/mol | 190.26 | | | | |
| Z | 6 | | | | |
| Dx, g/cm3 | 6.310 | | | | |
| a, Å | 4.12218(20) | | | | |
| c, Å | 17.67247(88) | | | | |
| Cell Volume (Å3) | 300.297(33) | | | | |
| d | 2Θ | h | k | l | I% |
| 4.4181 | 20.082 | 0 | 0 | 4 | 0 |
| 4.0144 | 22.125 | 0 | 1 | 1 | 0 |
| 3.3774 | 26.367 | 0 | 1 | 3 | 86 |
| 2.9454 | 30.321 | 0 | 0 | 6 | 14 |
| 2.9148 | 30.647 | 1 | 1 | 0 | 32 |
| 2.7681 | 32.315 | 1 | 1 | 2 | 1 |
| 2.6832 | 33.367 | 0 | 1 | 5 | 0 |
| 2.4330 | 36.915 | 1 | 1 | 4 | 1 |
| 2.2091 | 40.816 | 0 | 0 | 8 | 2 |
| 2.1529 | 41.929 | 0 | 1 | 7 | 1 |
| 2.0718 | 43.653 | 1 | 1 | 6 | 100 |
| 2.0611 | 43.892 | 0 | 2 | 0 | 57 |
| 2.0072 | 45.134 | 0 | 2 | 2 | 1 |
| 1.8678 | 48.711 | 0 | 2 | 4 | 0 |
| 1.8336 | 49.684 | 2 | 1 | 1 | 0 |
| 1.8336 | 49.684 | 1 | 2 | 1 | 0 |
| 1.7728 | 51.510 | 0 | 1 | 9 | 61 |
| 1.7673 | 51.682 | 0 | 0 | 10 | 0 |
| 1.7606 | 51.892 | 1 | 1 | 8 | 1 |
| 1.7594 | 51.931 | 2 | 1 | 3 | 0 |
| 1.7594 | 51.931 | 1 | 2 | 3 | 0 |
| 1.6887 | 54.278 | 0 | 2 | 6 | 42 |
| 1.6345 | 56.233 | 2 | 1 | 5 | 1 |
| 1.6345 | 56.233 | 1 | 2 | 5 | 1 |
| 1.5112 | 61.292 | 1 | 1 | 10 | 1 |
| 1.5070 | 61.480 | 0 | 2 | 8 | 0 |
| 1.4969 | 61.940 | 0 | 1 | 11 | 1 |
| 1.4888 | 62.314 | 1 | 2 | 7 | 0 |
| 1.4888 | 62.314 | 2 | 1 | 7 | 0 |
| 1.4727 | 63.074 | 0 | 0 | 12 | 12 |
| 1.4574 | 63.814 | 2 | 2 | 0 | 33 |
| 1.4380 | 64.780 | 2 | 2 | 2 | 0 |
| 1.3841 | 67.635 | 2 | 2 | 4 | 1 |
| 1.3699 | 68.429 | 0 | 3 | 1 | 2 |
| 1.3440 | 69.938 | 1 | 2 | 9 | 0 |
| 1.3440 | 69.938 | 2 | 1 | 9 | 0 |
| 1.3416 | 70.082 | 0 | 2 | 10 | 0 |
| 1.3381 | 70.290 | 0 | 3 | 3 | 48 |
| 1.3145 | 71.750 | 1 | 1 | 12 | 24 |
| 1.3063 | 72.272 | 2 | 2 | 6 | 26 |
| 1.3036 | 72.445 | 3 | 1 | 0 | 0 |
| 1.3036 | 72.445 | 1 | 3 | 0 | 0 |
| 1.2910 | 73.261 | 0 | 1 | 13 | 0 |
| 1.2896 | 73.356 | 3 | 1 | 2 | 0 |
| 1.2896 | 73.356 | 1 | 3 | 2 | 0 |
| 1.2807 | 73.951 | 0 | 3 | 5 | 1 |
| 1.2623 | 75.211 | 0 | 0 | 14 | 1 |
| 1.2503 | 76.065 | 1 | 3 | 4 | 0 |
| 1.2503 | 76.065 | 3 | 1 | 4 | 0 |
| 1.2165 | 78.573 | 2 | 2 | 8 | 0 |
| 1.2112 | 78.986 | 2 | 1 | 11 | 0 |
| 1.2112 | 78.986 | 1 | 2 | 11 | 0 |
| 1.2069 | 79.323 | 0 | 3 | 7 | 2 |
| 1.1983 | 80.009 | 0 | 2 | 12 | 34 |
| 1.1920 | 80.513 | 3 | 1 | 6 | 48 |
| 1.1920 | 80.513 | 1 | 3 | 6 | 48 |
| 1.1584 | 83.363 | 1 | 1 | 14 | 3 |

**Table S3**. XRD data of Sample 3.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase name | Ba0.43(1)Gd0.38(1)Ln0.11(1)Na0.08(2)F2.41 | | | | |
| R-Bragg | 6.165 | | | | |
| Spacegroup | *I4* | | | | |
| Mol. Mass, g/mol | 185.48 | | | | |
| Z | 6 | | | | |
| Dx, g/cm3 | 6.150 | | | | |
| a, Å | 4.12250(22) | | | | |
| c, Å | 17.6738(10) | | | | |
| Cell Volume (Å3) | 300.367(37) | | | | |
| d | 2Θ | h | k | l | I% |
| 4.4185 | 20.080 | 0 | 0 | 4 | 0 |
| 4.0147 | 22.124 | 0 | 1 | 1 | 0 |
| 3.3777 | 26.365 | 0 | 1 | 3 | 89 |
| 2.9456 | 30.319 | 0 | 0 | 6 | 15 |
| 2.9151 | 30.645 | 1 | 1 | 0 | 33 |
| 2.7683 | 32.312 | 1 | 1 | 2 | 1 |
| 2.6834 | 33.364 | 0 | 1 | 5 | 0 |
| 2.4332 | 36.912 | 1 | 1 | 4 | 1 |
| 2.2092 | 40.812 | 0 | 0 | 8 | 2 |
| 2.1531 | 41.925 | 0 | 1 | 7 | 1 |
| 2.0720 | 43.649 | 1 | 1 | 6 | 100 |
| 2.0613 | 43.888 | 0 | 2 | 0 | 61 |
| 2.0074 | 45.131 | 0 | 2 | 2 | 1 |
| 1.8680 | 48.707 | 0 | 2 | 4 | 0 |
| 1.8337 | 49.679 | 1 | 2 | 1 | 0 |
| 1.8337 | 49.679 | 2 | 1 | 1 | 0 |
| 1.7729 | 51.505 | 0 | 1 | 9 | 60 |
| 1.7674 | 51.678 | 0 | 0 | 10 | 0 |
| 1.7607 | 51.888 | 1 | 1 | 8 | 0 |
| 1.7595 | 51.927 | 1 | 2 | 3 | 0 |
| 1.7595 | 51.927 | 2 | 1 | 3 | 0 |
| 1.6888 | 54.273 | 0 | 2 | 6 | 43 |
| 1.6347 | 56.228 | 1 | 2 | 5 | 1 |
| 1.6347 | 56.228 | 2 | 1 | 5 | 1 |
| 1.5113 | 61.286 | 1 | 1 | 10 | 1 |
| 1.5071 | 61.475 | 0 | 2 | 8 | 0 |
| 1.4970 | 61.935 | 0 | 1 | 11 | 1 |
| 1.4889 | 62.309 | 1 | 2 | 7 | 0 |
| 1.4889 | 62.309 | 2 | 1 | 7 | 0 |
| 1.4728 | 63.069 | 0 | 0 | 12 | 12 |
| 1.4575 | 63.808 | 2 | 2 | 0 | 34 |
| 1.4381 | 64.774 | 2 | 2 | 2 | 0 |
| 1.3842 | 67.629 | 2 | 2 | 4 | 2 |
| 1.3700 | 68.423 | 0 | 3 | 1 | 2 |
| 1.3441 | 69.932 | 1 | 2 | 9 | 0 |
| 1.3441 | 69.932 | 2 | 1 | 9 | 0 |
| 1.3417 | 70.076 | 0 | 2 | 10 | 0 |
| 1.3382 | 70.284 | 0 | 3 | 3 | 52 |
| 1.3146 | 71.744 | 1 | 1 | 12 | 25 |
| 1.3064 | 72.265 | 2 | 2 | 6 | 22 |
| 1.3037 | 72.439 | 3 | 1 | 0 | 0 |
| 1.3037 | 72.439 | 1 | 3 | 0 | 0 |
| 1.2911 | 73.255 | 0 | 1 | 13 | 0 |
| 1.2897 | 73.350 | 1 | 3 | 2 | 1 |
| 1.2897 | 73.350 | 3 | 1 | 2 | 1 |
| 1.2808 | 73.944 | 0 | 3 | 5 | 0 |
| 1.2624 | 75.205 | 0 | 0 | 14 | 1 |
| 1.2504 | 76.058 | 3 | 1 | 4 | 0 |
| 1.2504 | 76.058 | 1 | 3 | 4 | 0 |

**Table S4**. XRD data of Sample 4.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase name | hkl\_Phase | | | | |
| R-Bragg | 8.194 | | | | |
| Spacegroup | *I4* | | | | |
| Mol. Mass, g/mol | 186.18 | | | | |
| Z | 6 | | | | |
| Dx, g/cm3 | 6.167 | | | | |
| a, Å | 4.12381(23) | | | | |
| c, Å | 17.6818(10) | | | | |
| Cell Volume (Å3) | 300.694(37) | | | | |
| d | 2Θ | h | k | l | I% |
| 4.4205 | 20.071 | 0 | 0 | 4 | 0 |
| 4.0160 | 22.116 | 0 | 1 | 1 | 0 |
| 3.3789 | 26.356 | 0 | 1 | 3 | 93 |
| 2.9470 | 30.305 | 0 | 0 | 6 | 15 |
| 2.9160 | 30.635 | 1 | 1 | 0 | 34 |
| 2.7692 | 32.301 | 1 | 1 | 2 | 1 |
| 2.6845 | 33.350 | 0 | 1 | 5 | 0 |
| 2.4341 | 36.898 | 1 | 1 | 4 | 1 |
| 2.2102 | 40.793 | 0 | 0 | 8 | 2 |
| 2.1540 | 41.907 | 0 | 1 | 7 | 1 |
| 2.0728 | 43.632 | 1 | 1 | 6 | 100 |
| 2.0619 | 43.874 | 0 | 2 | 0 | 63 |
| 2.0080 | 45.115 | 0 | 2 | 2 | 1 |
| 1.8686 | 48.690 | 0 | 2 | 4 | 0 |
| 1.8343 | 49.663 | 1 | 2 | 1 | 0 |
| 1.8343 | 49.663 | 2 | 1 | 1 | 0 |
| 1.7737 | 51.482 | 0 | 1 | 9 | 59 |
| 1.7682 | 51.653 | 0 | 0 | 10 | 0 |
| 1.7614 | 51.866 | 1 | 1 | 8 | 0 |
| 1.7601 | 51.908 | 1 | 2 | 3 | 72 |
| 1.7601 | 51.908 | 2 | 1 | 3 | 72 |
| 1.6894 | 54.252 | 0 | 2 | 6 | 43 |
| 1.6352 | 56.207 | 1 | 2 | 5 | 1 |
| 1.6352 | 56.207 | 2 | 1 | 5 | 1 |
| 1.5119 | 61.258 | 1 | 1 | 10 | 0 |
| 1.5077 | 61.449 | 0 | 2 | 8 | 1 |
| 1.4977 | 61.905 | 0 | 1 | 11 | 1 |
| 1.4895 | 62.284 | 1 | 2 | 7 | 0 |
| 1.4895 | 62.284 | 2 | 1 | 7 | 0 |
| 1.4735 | 63.037 | 0 | 0 | 12 | 12 |
| 1.4580 | 63.785 | 2 | 2 | 0 | 33 |
| 1.4386 | 64.751 | 2 | 2 | 2 | 0 |
| 1.3846 | 67.604 | 2 | 2 | 4 | 2 |
| 1.3705 | 68.398 | 0 | 3 | 1 | 2 |
| 1.3446 | 69.902 | 1 | 2 | 9 | 0 |
| 1.3446 | 69.902 | 2 | 1 | 9 | 0 |
| 1.3422 | 70.044 | 0 | 2 | 10 | 0 |
| 1.3387 | 70.258 | 0 | 3 | 3 | 54 |
| 1.3151 | 71.709 | 1 | 1 | 12 | 23 |
| 1.3068 | 72.236 | 2 | 2 | 6 | 27 |
| 1.3041 | 72.412 | 1 | 3 | 0 | 16 |
| 1.3041 | 72.412 | 3 | 1 | 0 | 16 |
| 1.2917 | 73.217 | 0 | 1 | 13 | 0 |
| 1.2901 | 73.322 | 1 | 3 | 2 | 0 |
| 1.2901 | 73.322 | 3 | 1 | 2 | 0 |
| 1.2812 | 73.915 | 0 | 3 | 5 | 0 |
| 1.2630 | 75.165 | 0 | 0 | 14 | 0 |
| 1.2508 | 76.029 | 1 | 3 | 4 | 0 |
| 1.2508 | 76.029 | 3 | 1 | 4 | 0 |

**Table S5**. XRD data of Sample 5.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Phase name | hkl\_Phase | | | | |
| R-Bragg | 0.086 | | | | |
| Spacegroup | *I4* | | | | |
| Mol. Mass, g/mol | 188.38 | | | | |
| Z | 6 | | | | |
| Dx, g/cm3 | 6.242 | | | | |
| a, Å | 4.12313(18) | | | | |
| c, Å | 17.68267(73) | | | | |
| Cell Volume (Å3) | 300.609(29) | | | | |
| d | 2Θ | h | k | l | I% |
| 4.4207 | 20.070 | 0 | 0 | 4 | 0 |
| 4.0154 | 22.120 | 0 | 1 | 1 | 0 |
| 3.3786 | 26.358 | 0 | 1 | 3 | 91 |
| 2.9471 | 30.303 | 0 | 0 | 6 | 15 |
| 2.9155 | 30.640 | 1 | 1 | 0 | 34 |
| 2.7688 | 32.306 | 1 | 1 | 2 | 1 |
| 2.4338 | 36.902 | 1 | 1 | 4 | 1 |
| 2.2103 | 40.791 | 0 | 0 | 8 | 3 |
| 2.1540 | 41.908 | 0 | 1 | 7 | 1 |
| 2.0727 | 43.635 | 1 | 1 | 6 | 100 |
| 2.0616 | 43.881 | 0 | 2 | 0 | 61 |
| 2.0077 | 45.122 | 0 | 2 | 2 | 1 |
| 1.8684 | 48.696 | 0 | 2 | 4 | 1 |
| 1.7737 | 51.481 | 0 | 1 | 9 | 60 |
| 1.6893 | 54.258 | 0 | 2 | 6 | 42 |
| 1.5119 | 61.259 | 1 | 1 | 10 | 0 |
| 1.5076 | 61.453 | 0 | 2 | 8 | 0 |
| 1.4977 | 61.904 | 0 | 1 | 11 | 1 |
| 1.4736 | 63.034 | 0 | 0 | 12 | 11 |
| 1.4578 | 63.797 | 2 | 2 | 0 | 32 |
| 1.3844 | 67.615 | 2 | 2 | 4 | 2 |
| 1.3702 | 68.411 | 0 | 3 | 1 | 2 |
| 1.3385 | 70.270 | 0 | 3 | 3 | 53 |
| 1.3151 | 71.708 | 1 | 1 | 12 | 27 |
| 1.3066 | 72.247 | 2 | 2 | 6 | 22 |
| 1.2810 | 73.927 | 0 | 3 | 5 | 3 |
| 1.2631 | 75.161 | 0 | 0 | 14 | 4 |
| 1.2169 | 78.542 | 2 | 2 | 8 | 2 |
| 1.2073 | 79.294 | 0 | 3 | 7 | 3 |
| 1.1988 | 79.965 | 0 | 2 | 12 | 34 |
| 1.1590 | 83.310 | 1 | 1 | 14 | 0 |