Supplementary Information

## Electron Crystallographic Investigation of Crystals on the Mesostructural Scale Wenting Mao 1, Chao Bao 1 & Lu Han 2\*

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1. Characterizations of the mesostructured crystal

图片包含 游戏机, 刷子

描述已自动生成

Fig. S1. SEM images of the SDD structure

1. 3D reconstruction of the mesostructured crystal

电脑萤幕画面

低可信度描述已自动生成

Fig. S2. Examples for defining over the area which is performed with the symmetry averaging.

The proper area for obtaining the symmetry averaged area through Fourier transformation was carefully chosen within the thin and intact area using the area selection tool in the image processing software CRISP (Fig. S2). The edge part containing incomplete structure without a full periodicity was also excluded. For both HAADF-STEM and TEM images, the same sample area was used.

卡通人物

低可信度描述已自动生成

Fig. S3. 2D unit cell marked in orange frames with the common origin in 3D space.

图片包含 游戏机

描述已自动生成

Fig. S4. (a1-5) HAADF-STEM images with camera length of 100mm and (b1-5) projections of the 3D electrostatic potential maps reconstructed. The symmetry-averaged images are overlapped on corresponding projections.

The HAADF-STEM performed using a large cutoff angle can avoid the coherent diffraction information in TEM mode. In this paper, TEM and STEM images were recorded on a JEOL JEM-F200 microscope with GATAN OneView IS camera. HAADF-STEM imaging with camera length of 120 mm was performed with the semi-angle range from 62.8 mrad to 230 mrad, which is the largest camera length we can choose. The probe current was 0.05 nA in STEM mode and dose on screen was 9.5 pA/cm2 in TEM mode. The instrument has not equipped with additional electron counting detector for sample. Thus, we estimated the electron dose arriving at the sample as follows:

**In STEM mode:**

scanning areaSTEM ≈ 1332.8 × 1332.8 nm2, scanning time = 10 s, 1 A = 1 C/s = 6.24 × 1018 e/s

electron doseSTEM ≈

= e/Å2

≈ 17.6 e/Å2

**In TEM mode:**

It is assumed that the electron beam entered the sample and reached the fluorescent screen with almost no loss. Therefore, the current at the sample is the same as that at the fluorescent screen ( Simaging area × Jcurrent density at the sample = S’fluorescent screen × Jcurrent density at the fluorescent screen). Magnification = 40 k, imaging time = 3 s.

S’fluorescent screen = Simaging area × M2 (magnification)

Jcurrent density at the sample = M2 × Jcurrent density at the fluorescent screen

electron doseTEM ≈ (40 × 103)2 × 9.5 pA/cm2 × 6.24 × 1018 e/s × 3 s

≈ 28.5 e/Å2

The nodal surface approximation formula:



where *h* = 1, *k* = 1, *l* = 1, coefficient = 1; *h* = 3, *k* = 3, *l* = 1, coefficient = 0.0235559; *h* = 5, *k* = 1, *l* = 1, coefficient = 0.00619501.

**Table S1.** Comparison of CSFs (amplitudes and phases extracted from corresponding HAADF-STEM/TEM images) along [001] direction. The amplitudes ≥ 2% of the largest amplitude are used for reconstruction. The phases extracted from the STEM images are shifted by 180° in order to compensate for the reversed contrast in the STEM images.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **HAADF-STEM, 120 mm** | | **HAADF-STEM, 100 mm** | | **Underfocused TEM** | | **Infocused TEM** | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** |
| 2 | 0 | 0 | 9567 | 180 | 9695 | 180 | 9587 | 180 | 9755 | 180 |
| 2 | 2 | 0 | 7204 | 180 | 7443 | 180 | 8064 | 180 | 7836 | 180 |
| 4 | 0 | 0 | 2477 | 0 | 2525 | 0 | 3128 | 0 | 2783 | 0 |
| 4 | 2 | 0 | 260 | 0 | 271 | 0 | 292 | 0 | 276 | 0 |
| 4 | 4 | 0 | 1790 | 180 | 1892 | 180 | 2532 | 180 | 1509 | 180 |
| 6 | 0 | 0 | 1887 | 0 | 2048 | 0 | 2881 | 0 | 1684 | 0 |
| 6 | 2 | 0 | 1148 | 0 | 1277 | 0 | 1783 | 0 | 1032 | 0 |
| 6 | 4 | 0 | 321 | 0 | 355 | 0 | 575 | 0 | 397 | 0 |
| 8 | 0 | 0 | 355 | 0 | 379 | 0 | 533 | 0 | 275 | 0 |
| 8 | 2 | 0 | 297 | 0 | 312 | 0 | 360 | 0 | 223 | 0 |
| 6 | 6 | 0 | 341 | 180 | 395 | 180 | 467 | 180 | 226 | 0 |
| 8 | 4 | 0 | 323 | 0 | 364 | 0 | 485 | 0 | 233 | 180 |
| 10 | 0 | 0 | / | / | / | / | 263 | 180 | / | / |
| 8 | 6 | 0 | / | / | / | / | 287 | 0 | / | / |
| 10 | 2 | 0 | / | / | / | / | 237 | 180 | / | / |

**Table S2.** Comparison of CSFs amplitudes and phases extracted from corresponding HAADF-STEM/TEM images) along [101] direction. The amplitudes ≥ 2% of the largest amplitude are used for reconstruction. The phases extracted from the STEM images are shifted by 180° in order to compensate for the reversed contrast in the STEM images.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **HAADF-STEM, 120 mm** | | **HAADF-STEM, 100 mm** | | **Underfocused TEM** | | **Infocused TEM** | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** |
| 1 | 0 | -1 | 10000 | 180 | 10000 | 180 | 10000 | 180 | 10000 | 180 |
| 0 | 2 | 0 | 4338 | 0 | 4097 | 0 | 5113 | 0 | 5054 | 0 |
| 1 | 2 | -1 | 2346 | 180 | 2199 | 180 | 2540 | 180 | 2736 | 180 |
| 2 | 0 | -2 | / | / | / | / | 236 | 0 | / | / |
| 2 | 2 | -2 | 246 | 0 | / | / | 268 | 0 | 221 | 0 |
| 0 | 4 | 0 | 2531 | 0 | 2357 | 0 | 4465 | 0 | 3685 | 0 |
| 3 | 0 | -3 | 1184 | 0 | 1148 | 0 | 1822 | 0 | 1570 | 0 |
| 1 | 4 | -1 | / | / | / | / | 406 | 0 | 244 | 0 |
| 3 | 2 | -3 | 380 | 180 | 382 | 180 | 697 | 180 | 515 | 180 |
| 2 | 4 | -2 | 240 | 180 | 222 | 180 | 484 | 180 | 363 | 180 |
| 4 | 0 | -4 | 276 | 180 | 246 | 180 | 384 | 180 | 534 | 180 |
| 3 | 4 | -3 | 590 | 180 | 578 | 180 | 1234 | 180 | 791 | 180 |
| 4 | 2 | -4 | 279 | 180 | 259 | 180 | 459 | 180 | 365 | 180 |
| 0 | 6 | 0 | 1156 | 180 | 1072 | 180 | 2773 | 180 | 1752 | 180 |
| 1 | 6 | -1 | 397 | 0 | 354 | 0 | 904 | 0 | 625 | 0 |
| 2 | 6 | -2 | / | / | / | / | 256 | 180 | / | / |
| 4 | 4 | -4 | 1092 | 180 | 1010 | 180 | 2032 | 180 | 1402 | 180 |
| 5 | 0 | -5 | 866 | 180 | 830 | 180 | 1444 | 180 | 1330 | 180 |
| 5 | 2 | -5 | 301 | 0 | 286 | 0 | 534 | 0 | 438 | 0 |
| 3 | 6 | -3 | 304 | 0 | 270 | 0 | 702 | 0 | 427 | 0 |
| 5 | 4 | -5 | 371 | 180 | 355 | 180 | 735 | 180 | 408 | 180 |
| 4 | 6 | -4 | 209 | 180 | / | / | 380 | 180 | 231 | 180 |
| 6 | 0 | -6 | 235 | 180 | 239 | 180 | 325 | 180 | 257 | 180 |
| 6 | 2 | -6 | 243 | 0 | 233 | 0 | 451 | 0 | 316 | 0 |
| 3 | 8 | -3 | / | / | / | / | 364 | 0 | / | / |
| 7 | 0 | -7 | 410 | 0 | 369 | 0 | 800 | 0 | 484 | 0 |
| 0 | 10 | 0 | / | / | / | / | 702 | 0 | / | / |
| 5 | 8 | -5 | / | / | / | / | 258 | 180 | / | / |
| 3 | 10 | -3 | / | / | / | / | 215 | 180 | / | / |
| 8 | 0 | -8 | 432 | 0 | 397 | 0 | 825 | 0 | 445 | 0 |
| 8 | 2 | -8 | / | / | / | / | 381 | 180 | / | / |
| 5 | 10 | -5 | / | / | / | / | 220 | 180 | / | / |
| 9 | 0 | -9 | / | / | / | / | 321 | 0 | / | / |

**Table S3.** Comparison of CSFs (amplitudes and phases extracted from corresponding HAADF-STEM/TEM images) along [110] direction. The amplitudes ≥ 2% of the largest amplitude are used for reconstruction. The phases extracted from the STEM images are shifted by 180° in order to compensate for the reversed contrast in the STEM images.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **HAADF-STEM, 120 mm** | | **HAADF-STEM, 100 mm** | | **Underfocused TEM** | | **Infocused TEM** | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** |
| 1 | -1 | 2 | 4225 | 0 | 4592 | 0 | 2892 | 0 | 4109 | 0 |
| 2 | -2 | 0 | 10000 | 180 | 10000 | 180 | 10000 | 180 | 10000 | 180 |
| 0 | 0 | 4 | 7204 | 0 | 7466 | 0 | 6369 | 0 | 6845 | 0 |
| 3 | -3 | 2 | 340 | 0 | 338 | 0 | 613 | 0 | 497 | 0 |
| 2 | -2 | 4 | 1423 | 180 | 1308 | 180 | 2171 | 180 | 1233 | 180 |
| 4 | -4 | 0 | 2144 | 180 | 1779 | 180 | 3968 | 180 | 2882 | 180 |
| 1 | -1 | 6 | 1138 | 180 | 1216 | 180 | 1239 | 180 | 1556 | 180 |
| 4 | -4 | 4 | 1205 | 180 | 1016 | 180 | 2598 | 180 | 1501 | 180 |
| 3 | -3 | 6 | 1888 | 0 | 1823 | 0 | 3910 | 0 | 2405 | 0 |
| 5 | -5 | 2 | / | / | / | / | 362 | 180 | / | / |
| 0 | 0 | 8 | 757 | 180 | 779 | 180 | 959 | 180 | 735 | 180 |
| 2 | -2 | 8 | 209 | 0 | / | / | / | / | / | / |
| 6 | -6 | 0 | 518 | 180 | 405 | 180 | 1027 | 180 | 601 | 180 |
| 5 | -5 | 6 | 245 | 0 | 225 | 0 | 517 | 0 | 405 | 0 |
| 6 | -6 | 4 | 366 | 180 | 274 | 180 | 952 | 180 | 477 | 180 |
| 4 | -4 | 8 | 571 | 0 | 518 | 0 | 1377 | 0 | 560 | 0 |
| 1 | -1 | 10 | 290 | 0 | 330 | 0 | 768 | 0 | 533 | 0 |
| 7 | -7 | 2 | / | / | / | / | 382 | 180 | / | / |
| 3 | -3 | 10 | 379 | 180 | 343 | 180 | 895 | 180 | 456 | 180 |
| 8 | -8 | 0 | / | / | / | / | 270 | 0 | / | / |
| 7 | -7 | 6 | / | / | / | / | 416 | 180 | / | / |
| 0 | 0 | 12 | / | / | / | / | 1132 | 180 | 262 | 180 |
| 2 | -2 | 12 | / | / | / | / | 917 | 0 | / | / |
| 9 | -9 | 2 | / | / | / | / | 233 | 180 | / | / |
| 4 | -4 | 12 | / | / | / | / | 696 | 180 | / | / |
| 1 | -1 | 14 | / | / | / | / | 460 | 180 | / | / |
| 7 | -7 | 10 | / | / | / | / | 504 | 0 | / | / |
| 9 | -9 | 6 | / | / | / | / | 296 | 180 | / | / |
| 10 | -10 | 0 | / | / | / | / | 381 | 0 | / | / |
| 3 | -3 | 14 | / | / | / | / | 316 | 0 | / | / |
| 10 | -10 | 4 | / | / | / | / | 232 | 0 | / | / |
| 0 | 0 | 16 | / | / | / | / | 864 | 0 | / | / |
| 2 | -2 | 16 | / | / | / | / | 579 | 180 | / | / |
| 4 | -4 | 16 | / | / | / | / | 269 | 0 | / | / |
| 1 | -1 | 18 | / | / | / | / | 267 | 0 | / | / |
| 0 | 0 | 20 | / | / | / | / | 281 | 180 | / | / |

**Table S4.** Comparison of CSFs (amplitudes and phases extracted from corresponding HAADF-STEM/TEM images) along [111] direction. The amplitudes ≥ 2% of the largest amplitude are used for reconstruction. The phases extracted from the STEM images are shifted by 180° in order to compensate for the reversed contrast in the STEM images.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **HAADF-STEM, 120 mm** | | **HAADF-STEM, 100 mm** | | **Underfocused TEM** | | **Infocused TEM** | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** |
| 0 | -1 | 1 | 9922 | 0 | 9952 | 0 | 8792 | 0 | 8910 | 0 |
| 1 | -1 | 0 | 2194 | 180 | 2213 | 180 | 1251 | 180 | 1216 | 180 |
| -1 | -1 | 2 | 757 | 180 | 805 | 180 | 986 | 180 | 963 | 180 |
| 1 | -2 | 1 | 739 | 180 | 684 | 180 | 1087 | 180 | 905 | 180 |
| 0 | -2 | 2 | 870 | 180 | 755 | 180 | 1337 | 180 | 1326 | 180 |
| 2 | -2 | 0 | 3308 | 180 | 3105 | 180 | 5102 | 180 | 4123 | 180 |
| -1 | -2 | 3 | 717 | 0 | 691 | 0 | 1064 | 0 | 1019 | 0 |
| 1 | -3 | 2 | 855 | 0 | 774 | 0 | 1520 | 0 | 839 | 0 |
| 2 | -3 | 1 | 639 | 0 | 522 | 0 | 1259 | 0 | 1053 | 0 |
| 0 | -3 | 3 | 1253 | 180 | 1173 | 180 | 2414 | 180 | 1715 | 180 |
| 3 | -3 | 0 | 622 | 180 | 571 | 180 | 1731 | 180 | 1118 | 180 |
| -2 | -2 | 4 | 1154 | 180 | 1062 | 180 | 2625 | 180 | 1641 | 180 |
| 2 | -4 | 2 | / | / | / | / | 320 | 180 | 211 | 180 |
| -1 | -3 | 4 | 872 | 0 | 776 | 0 | 2088 | 0 | 1265 | 0 |
| 1 | -4 | 3 | 511 | 0 | 458 | 0 | 1338 | 0 | 924 | 0 |
| 3 | -4 | 1 | 458 | 180 | 391 | 180 | 1254 | 180 | 555 | 180 |
| 0 | -4 | 4 | 452 | 0 | 365 | 0 | 1267 | 0 | 850 | 0 |
| 4 | -4 | 0 | 711 | 180 | 574 | 180 | 2603 | 180 | 1190 | 180 |
| -2 | -3 | 5 | 1153 | 0 | 950 | 0 | 2858 | 0 | 1816 | 0 |
| 2 | -5 | 3 | 331 | 0 | 270 | 0 | 1218 | 0 | 437 | 0 |
| 3 | -5 | 2 | / | / | / | / | 398 | 0 | / | / |
| -1 | -4 | 5 | 1237 | 180 | 961 | 180 | 3519 | 180 | 1974 | 180 |
| 1 | -5 | 4 | 943 | 180 | 770 | 180 | 3328 | 180 | 1724 | 180 |
| 4 | -5 | 1 | / | / | / | / | 519 | 180 | 263 | 180 |
| 0 | -5 | 5 | 486 | 0 | 403 | 0 | 1484 | 0 | 708 | 0 |
| 5 | -5 | 0 | / | / | / | / | 1021 | 180 | 484 | 180 |
| -3 | -3 | 6 | 238 | 0 | / | / | 620 | 0 | 382 | 0 |
| 3 | -6 | 3 | / | / | / | / | 850 | 0 | 366 | 0 |
| -2 | -4 | 6 | 340 | 180 | 227 | 180 | 912 | 180 | 515 | 180 |
| 2 | -6 | 4 | / | / | / | / | 880 | 180 | 299 | 180 |
| -1 | -5 | 6 | 650 | 0 | 473 | 0 | 2203 | 0 | 1095 | 0 |
| 1 | -6 | 5 | 508 | 0 | 378 | 0 | 2344 | 0 | 1029 | 0 |
| 5 | -6 | 1 | / | / | / | / | 812 | 180 | 244 | 180 |
| 0 | -6 | 6 | 556 | 180 | 412 | 180 | 2221 | 180 | 967 | 180 |
| 6 | -6 | 0 | / | / | / | / | 600 | 180 | 222 | 180 |
| -3 | -4 | 7 | 391 | 0 | 287 | 0 | 1275 | 0 | 761 | 0 |
| 4 | -7 | 3 | / | / | / | / | 381 | 180 | / | / |
| -2 | -5 | 7 | 247 | 180 | / | / | 855 | 180 | 484 | 180 |
| -1 | -6 | 7 | / | / | / | / | 386 | 180 | / | / |
| 1 | -7 | 6 | / | / | / | / | 230 | 180 | / | / |
| 6 | -7 | 1 | / | / | / | / | 683 | 180 | 214 | 180 |
| -4 | -4 | 8 | / | / | / | / | 674 | 0 | 376 | 0 |
| 4 | -8 | 4 | / | / | / | / | 426 | 0 | / | / |
| -3 | -5 | 8 | 219 | 180 | / | / | 742 | 180 | 433 | 180 |
| 0 | -7 | 7 | / | / | / | / | 842 | 0 | 332 | 0 |
| 3 | -8 | 5 | / | / | / | / | 737 | 180 | / | / |
| 7 | -7 | 0 | / | / | / | / | 394 | 180 | / | / |
| -2 | -6 | 8 | / | / | / | / | 706 | 0 | 361 | 0 |
| 2 | -8 | 6 | / | / | / | / | 564 | 0 | / | / |
| -1 | -7 | 8 | / | / | / | / | 588 | 180 | 293 | 180 |
| 1 | -8 | 7 | / | / | / | / | 655 | 180 | 205 | 180 |
| -4 | -5 | 9 | / | / | / | / | 310 | 0 | / | / |
| 4 | -9 | 5 | / | / | / | / | 532 | 180 | / | / |
| 5 | -9 | 4 | / | / | / | / | 667 | 0 | / | / |
| -3 | -6 | 9 | / | / | / | / | 205 | 180 | / | / |
| 3 | -9 | 6 | / | / | / | / | 526 | 0 | / | / |
| 0 | -8 | 8 | / | / | / | / | 488 | 0 | 205 | 0 |
| 8 | -8 | 0 | / | / | / | / | 209 | 0 | / | / |
| -1 | -8 | 9 | / | / | / | / | 288 | 0 | / | / |
| 8 | -9 | 1 | / | / | / | / | 382 | 180 | / | / |
| -5 | -5 | 10 | / | / | / | / | 228 | 0 | / | / |
| 5 | -10 | 5 | / | / | / | / | 480 | 180 | / | / |
| -4 | -6 | 10 | / | / | / | / | 240 | 180 | / | / |
| 6 | -10 | 4 | / | / | / | / | 420 | 0 | / | / |
| -3 | -7 | 10 | / | / | / | / | 208 | 0 | / | / |
| 7 | -10 | 3 | / | / | / | / | 269 | 180 | / | / |
| 0 | -9 | 9 | / | / | / | / | 692 | 180 | 247 | 180 |
| -2 | -8 | 10 | / | / | / | / | 251 | 180 | / | / |
| 2 | -10 | 8 | / | / | / | / | 390 | 180 | / | / |
| -5 | -6 | 11 | / | / | / | / | 297 | 0 | / | / |
| -1 | -9 | 10 | / | / | / | / | 225 | 0 | / | / |
| 1 | -10 | 9 | / | / | / | / | 466 | 0 | / | / |
| -4 | -7 | 11 | / | / | / | / | 275 | 180 | / | / |
| 7 | -11 | 4 | / | / | / | / | 358 | 0 | / | / |
| -3 | -8 | 11 | / | / | / | / | 215 | 0 | / | / |
| 8 | -11 | 3 | / | / | / | / | 203 | 180 | / | / |
| 0 | -10 | 10 | / | / | / | / | 329 | 0 | / | / |
| 2 | -11 | 9 | / | / | / | / | 257 | 0 | / | / |
| -6 | -6 | 12 | / | / | / | / | 302 | 0 | / | / |
| -5 | -7 | 12 | / | / | / | / | 325 | 180 | / | / |
| 1 | -11 | 10 | / | / | / | / | 395 | 180 | / | / |
| -4 | -8 | 12 | / | / | / | / | 265 | 0 | / | / |
| -3 | -9 | 12 | / | / | / | / | 214 | 180 | / | / |

**Table S5.** Comparison of CSFs (amplitudes and phases extracted from corresponding HAADF-STEM/TEM images) along [010] direction. The amplitudes ≥ 2% of the largest amplitude are used for reconstruction. The phases extracted from the STEM images are shifted by 180° in order to compensate for the reversed contrast in the STEM images.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **HAADF-STEM, 120 mm** | | **HAADF-STEM, 100 mm** | | **Underfocused TEM** | | **Infocused TEM** | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** |
| 1 | 0 | 1 | 9849 | 180 | 9820 | 180 | 9402 | 180 | 9326 | 180 |
| 0 | 0 | 2 | 1825 | 0 | 1081 | 0 | 524 | 180 | 444 | 0 |
| 2 | 0 | 0 | 2855 | 180 | 3354 | 180 | 4296 | 180 | 4052 | 180 |
| 2 | 0 | 2 | 2182 | 180 | 2353 | 180 | 3176 | 180 | 3010 | 180 |
| 3 | 0 | 1 | 397 | 0 | / | / | 642 | 180 | 382 | 0 |
| 0 | 0 | 4 | 1910 | 0 | 1959 | 0 | 2280 | 0 | 2251 | 0 |
| 4 | 0 | 0 | 1365 | 0 | 1293 | 0 | 2149 | 0 | 1867 | 0 |
| 3 | 0 | 3 | 213 | 0 | 211 | 0 | 377 | 0 | 294 | 0 |
| 2 | 0 | 4 | 293 | 0 | 412 | 0 | 726 | 0 | 559 | 0 |
| 4 | 0 | 2 | 453 | 0 | 438 | 0 | 654 | 0 | 604 | 0 |
| 1 | 0 | 5 | 1225 | 0 | 1343 | 0 | 1971 | 0 | 1731 | 0 |
| 5 | 0 | 1 | 875 | 0 | 1008 | 0 | 1617 | 0 | 1227 | 0 |
| 4 | 0 | 4 | 577 | 0 | 681 | 0 | 1147 | 0 | 896 | 0 |
| 3 | 0 | 5 | 927 | 0 | 1055 | 0 | 1854 | 0 | 1448 | 0 |
| 5 | 0 | 3 | / | / | / | / | 220 | 0 | / | / |
| 0 | 0 | 6 | 714 | 180 | 409 | 180 | 529 | 180 | 453 | 180 |
| 6 | 0 | 0 | 558 | 0 | 734 | 0 | 1123 | 0 | 701 | 0 |
| 2 | 0 | 6 | 363 | 180 | / | / | 416 | 180 | 289 | 180 |
| 6 | 0 | 2 | 309 | 0 | 421 | 0 | 670 | 0 | 423 | 0 |
| 5 | 0 | 5 | 262 | 0 | 326 | 0 | 547 | 0 | 342 | 0 |
| 7 | 0 | 1 | 227 | 0 | 313 | 0 | 449 | 0 | / | / |
| 4 | 0 | 6 | 946 | 0 | 993 | 0 | 2117 | 0 | 1482 | 0 |
| 6 | 0 | 4 | 317 | 180 | 274 | 180 | 656 | 180 | 443 | 180 |
| 3 | 0 | 7 | 451 | 180 | 289 | 180 | 870 | 180 | 549 | 180 |
| 2 | 0 | 8 | / | / | / | / | 228 | 0 | / | / |
| 6 | 0 | 6 | / | / | / | / | 265 | 180 | / | / |
| 5 | 0 | 7 | 512 | 0 | 511 | 0 | 1202 | 0 | 736 | 0 |
| 7 | 0 | 5 | 328 | 180 | 366 | 180 | 776 | 180 | 409 | 180 |
| 1 | 0 | 9 | 217 | 180 | 232 | 180 | 597 | 180 | 364 | 180 |
| 3 | 0 | 9 | 225 | 180 | 209 | 180 | 607 | 180 | 358 | 180 |
| 7 | 0 | 7 | / | / | / | / | 314 | 180 | / | / |
| 0 | 0 | 10 | 321 | 0 | / | / | 523 | 0 | 260 | 0 |
| 8 | 0 | 6 | 205 | 180 | 241 | 180 | 507 | 180 | / | / |
| 5 | 0 | 9 | / | / | / | / | 439 | 0 | 217 | 0 |
| 4 | 0 | 10 | / | / | / | / | 664 | 180 | 324 | 180 |
| 1 | 0 | 11 | / | / | / | / | 223 | 0 | / | / |
| 3 | 0 | 11 | / | / | / | / | 368 | 0 | / | / |
| 7 | 0 | 9 | / | / | / | / | 424 | 180 | / | / |
| 9 | 0 | 7 | / | / | / | / | 218 | 180 | / | / |
| 6 | 0 | 10 | / | / | / | / | 383 | 0 | / | / |
| 0 | 0 | 12 | / | / | / | / | 348 | 180 | / | / |
| 2 | 0 | 12 | / | / | / | / | 378 | 180 | / | / |
| 8 | 0 | 10 | / | / | / | / | 425 | 180 | / | / |
| 6 | 0 | 12 | / | / | / | / | 336 | 0 | / | / |
| 5 | 0 | 13 | / | / | / | / | 333 | 180 | / | / |
| 7 | 0 | 13 | / | / | / | / | 231 | 0 | / | / |

**Table S6.** Comparison of CSFs after being combined and scaled from five different directions. The amplitudes are scaled based on the strongest amplitude. The phases extracted from the STEM images are shifted by 180° in order to compensate for the reversed contrast in the STEM images. The phases different from HAADF-STEM (120 mm) are marked red color.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | **HAADF-STEM, 120 mm** | | **HAADF-STEM, 100 mm** | | **Underfocused TEM** | | **Infocused TEM** | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** |
| 1 | 0 | -1 | 10000 | 180 | 10000 | 180 | 10000 | 180 | 10000 | 180 |
| 0 | 2 | 0 | 4456 | 0 | 4447 | 0 | 6171 | 0 | 5764 | 0 |
| 1 | -2 | -1 | 1524 | 180 | 1427 | 180 | 1879 | 180 | 1893 | 180 |
| 1 | -1 | -2 | 1562 | 0 | 1741 | 0 | 1578 | 0 | 1887 | 0 |
| 2 | -2 | 0 | 4614 | 180 | 4637 | 180 | 6575 | 180 | 5862 | 180 |
| 0 | 2 | -2 | 1109 | 180 | 1543 | 180 | 1736 | 180 | 1630 | 180 |
| 0 | 1 | 3 | 662 | 180 | 645 | 180 | 1242 | 180 | 1105 | 180 |
| 0 | 3 | 1 | 491 | 180 | 513 | 180 | 1010 | 180 | 658 | 180 |
| 1 | -3 | 2 | 921 | 0 | 869 | 0 | 1572 | 0 | 954 | 0 |
| 1 | -2 | 3 | 773 | 0 | 776 | 0 | 1100 | 0 | 1159 | 0 |
| 2 | -3 | 1 | 688 | 0 | 586 | 0 | 1302 | 0 | 1197 | 0 |
| 0 | 4 | 0 | 1810 | 0 | 1699 | 0 | 3259 | 0 | 2647 | 0 |
| 0 | 0 | 4 | 1643 | 0 | 1675 | 0 | 2242 | 0 | 2083 | 0 |
| 3 | 0 | -3 | 899 | 0 | 869 | 0 | 1603 | 0 | 1280 | 0 |
| 1 | -4 | -1 | / | / | / | / | 421 | 0 | 246 | 0 |
| 4 | -2 | 0 | 174 | 0 | 175 | 0 | 256 | 0 | 225 | 0 |
| 0 | 2 | -4 | 644 | 180 | 641 | 180 | 1176 | 180 | 715 | 180 |
| 0 | 4 | -2 | 339 | 180 | 314 | 180 | 522 | 180 | 413 | 180 |
| 3 | -2 | -3 | 365 | 180 | 362 | 180 | 723 | 180 | 519 | 180 |
| 3 | -3 | -2 | 186 | 180 | 190 | 180 | 453 | 180 | 324 | 180 |
| 2 | -4 | -2 | 230 | 180 | 211 | 180 | 416 | 180 | 303 | 180 |
| 2 | -2 | -4 | 1011 | 180 | 963 | 180 | 2159 | 180 | 1335 | 180 |
| 0 | 1 | 5 | 1074 | 0 | 1015 | 0 | 2620 | 0 | 1763 | 0 |
| 1 | -4 | 3 | 551 | 0 | 514 | 0 | 1384 | 0 | 1051 | 0 |
| 1 | -3 | 4 | 940 | 0 | 871 | 0 | 2160 | 0 | 1438 | 0 |
| 3 | -4 | 1 | 493 | 180 | 439 | 180 | 1297 | 180 | 631 | 180 |
| 0 | 5 | 1 | 863 | 0 | 959 | 0 | 1250 | 0 | 788 | 0 |
| 4 | -4 | 0 | 1044 | 180 | 955 | 180 | 2614 | 180 | 1487 | 180 |
| 0 | 4 | -4 | 495 | 0 | 465 | 0 | 1513 | 0 | 856 | 0 |
| 3 | -4 | -3 | 566 | 180 | 548 | 180 | 1280 | 180 | 797 | 180 |
| 0 | 5 | -3 | 357 | 180 | 303 | 180 | 753 | 180 | 497 | 180 |
| 0 | 3 | 5 | 1078 | 180 | 1035 | 180 | 1968 | 180 | 1793 | 180 |
| 4 | -2 | -4 | 268 | 180 | 246 | 180 | 476 | 180 | 368 | 180 |
| 6 | 0 | 0 | 973 | 0 | 1013 | 0 | 2219 | 0 | 1291 | 0 |
| 1 | -6 | -1 | 381 | 0 | 336 | 0 | 938 | 0 | 630 | 0 |
| 1 | -1 | -6 | 622 | 0 | 683 | 0 | 915 | 0 | 1014 | 0 |
| 2 | -3 | 5 | 1242 | 0 | 1067 | 0 | 2956 | 0 | 2065 | 0 |
| 2 | -5 | 3 | / | / | / | / | 1260 | 0 | / | / |
| 3 | -5 | 2 | / | / | / | / | 412 | 0 | / | / |
| 6 | -2 | 0 | 767 | 0 | 825 | 0 | 1561 | 0 | 840 | 0 |
| 0 | 2 | -6 | 319 | 180 | 238 | 180 | 566 | 180 | 402 | 180 |
| 0 | 6 | -2 | 305 | 0 | 400 | 0 | 508 | 0 | 444 | 0 |
| 1 | -5 | 4 | 1016 | 180 | 865 | 180 | 3442 | 180 | 1960 | 180 |
| 1 | -4 | 5 | 1333 | 180 | 1079 | 180 | 3640 | 180 | 2244 | 180 |
| 4 | -5 | -1 | / | / | / | / | 537 | 0 | 299 | 0 |
| 2 | -6 | -2 | / | / | / | / | 266 | 180 | / | / |
| 4 | -4 | -4 | 853 | 180 | 764 | 180 | 2013 | 180 | 1196 | 180 |
| 5 | 0 | -5 | 538 | 180 | 517 | 180 | 1215 | 180 | 835 | 180 |
| 0 | 7 | 1 | 224 | 180 | 298 | 180 | 490 | 180 | 243 | 180 |
| 0 | 1 | 7 | / | / | / | / | 538 | 180 | 233 | 180 |
| 6 | -4 | 0 | 214 | 0 | 229 | 0 | 504 | 0 | 323 | 0 |
| 0 | 6 | -4 | 238 | 0 | 207 | 0 | 626 | 0 | 337 | 0 |
| 0 | 4 | -6 | 650 | 180 | 600 | 180 | 1658 | 180 | 1071 | 180 |
| 5 | -2 | -5 | 289 | 0 | 271 | 0 | 554 | 0 | 441 | 0 |
| 3 | -6 | -3 | 292 | 0 | 256 | 0 | 804 | 0 | 423 | 0 |
| 3 | -3 | -6 | 644 | 180 | 1024 | 180 | 1765 | 180 | 1001 | 180 |
| 5 | -5 | -2 | / | / | / | / | 267 | 0 | / | / |
| 2 | -4 | 6 | 366 | 180 | 255 | 180 | 943 | 180 | 585 | 180 |
| 2 | -6 | 4 | / | / | / | / | 910 | 180 | 340 | 180 |
| 0 | 3 | -7 | 433 | 0 | 299 | 0 | 1147 | 0 | 721 | 0 |
| 0 | 7 | 3 | / | / | / | / | 336 | 0 | / | / |
| 1 | -6 | 5 | 547 | 0 | 424 | 0 | 2424 | 0 | 1170 | 0 |
| 1 | -5 | -6 | 700 | 180 | 531 | 180 | 2279 | 180 | 1245 | 180 |
| 5 | -6 | 1 | / | / | / | / | 840 | 180 | 277 | 180 |
| 0 | 8 | 0 | 237 | 0 | 245 | 0 | 467 | 0 | 224 | 0 |
| 0 | 0 | 8 | 414 | 180 | 407 | 180 | 580 | 180 | 387 | 180 |
| 5 | -4 | -5 | 356 | 180 | 337 | 180 | 762 | 180 | 411 | 180 |
| 8 | -2 | 0 | 198 | 0 | 202 | 0 | 315 | 0 | 182 | 0 |
| 4 | -6 | -4 | 201 | 180 | / | / | 394 | 180 | 233 | 180 |
| 0 | 2 | -8 | 114 | 180 | / | / | 406 | 180 | 410 | 180 |
| 6 | -6 | 0 | 255 | 180 | 241 | 180 | 596 | 180 | 276 | 180 |
| 6 | 0 | -6 | 412 | 180 | 345 | 180 | 977 | 180 | 679 | 180 |
| 0 | 5 | -7 | 386 | 180 | 486 | 180 | 1116 | 180 | 662 | 180 |
| 3 | -4 | 7 | 421 | 0 | 322 | 0 | 1319 | 0 | 865 | 0 |
| 0 | 7 | -5 | 324 | 180 | 348 | 180 | 577 | 180 | 430 | 180 |
| 4 | -7 | 3 | / | / | / | / | 394 | 180 | / | / |
| 6 | -2 | -6 | 233 | 0 | 221 | 180 | 468 | 0 | 318 | 0 |
| 2 | -5 | 7 | 266 | 180 | / | / | 884 | 180 | 550 | 180 |
| 8 | -4 | 0 | 216 | 0 | 235 | 0 | 425 | 0 | 190 | 0 |
| 0 | 4 | 8 | 312 | 0 | 291 | 0 | 857 | 0 | 396 | 0 |
| 0 | 8 | -4 | / | / | / | / | 441 | 0 | / | / |
| 0 | 1 | 9 | 214 | 180 | 221 | 180 | 529 | 180 | 382 | 180 |
| 3 | -8 | -3 | / | / | / | / | 378 | 0 | / | / |
|  | | | **HAADF-STEM, 120 mm** | | **HAADF-STEM, 100 mm** | | **Underfocused TEM** | | **Infocused TEM** | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** | **Amplitude** | **Phase** |
| 0 | 9 | -1 | / | / | / | / | 395 | 0 | / | / |
| 5 | -5 | -6 | 134 | 180 | 126 | 180 | 382 | 180 | 264 | 180 |
| 1 | -7 | 6 | / | / | / | / | 238 | 180 | / | / |
| 1 | -6 | 7 | / | / | / | / | 399 | 180 | / | / |
| 6 | -7 | 1 | / | / | / | / | 706 | 180 | / | / |
| 6 | -6 | -4 | 200 | 180 | 154 | 180 | 703 | 180 | 311 | 180 |
| 0 | 3 | -9 | 222 | 180 | 199 | 0 | 446 | 180 | 376 | 180 |
| 7 | 0 | -7 | 393 | 180 | 350 | 180 | 684 | 0 | 433 | 180 |
| 3 | -5 | 8 | 236 | 0 | / | / | 767 | 0 | 492 | 0 |
| 3 | -8 | 5 | / | / | / | / | 762 | 180 | / | / |
| 0 | 10 | 0 | / | / | / | / | 479 | 0 | / | / |
| 8 | -6 | 0 | / | / | / | / | 251 | 0 | / | / |
| 0 | 6 | -8 | / | / | / | / | 490 | 0 | / | / |
| 0 | 8 | -6 | 202 | 0 | 229 | 0 | 576 | 0 | / | / |
| 1 | -1 | -10 | 159 | 0 | 185 | 0 | 567 | 180 | 347 | 0 |
| 7 | -7 | -2 | / | / | / | / | 282 | 0 | / | / |
| 10 | -2 | 0 | / | / | / | / | 208 | 180 | / | / |
| 0 | 2 | -10 | / | / | / | / | 260 | 180 | / | / |
| 2 | -8 | 6 | / | / | / | / | 583 | 0 | / | / |
| 2 | -6 | 8 | / | / | / | / | 730 | 0 | / | / |
| 0 | 5 | -9 | / | / | / | / | 406 | 180 | 228 | 180 |
| 0 | 9 | -5 | / | / | / | / | 550 | 180 | / | / |
| 5 | -8 | -5 | / | / | / | / | 268 | 180 | / | / |
| 1 | -8 | 7 | / | / | / | / | 677 | 180 | / | / |
| 1 | -7 | 8 | / | / | / | / | 608 | 180 | 333 | 180 |
| 0 | 10 | -4 | / | / | / | / | 303 | 0 | / | / |
| 0 | 4 | -10 | / | / | / | / | 496 | 0 | 340 | 0 |
| 3 | -3 | -10 | 207 | 180 | 193 | 180 | 661 | 0 | 297 | 180 |
| 3 | -10 | -3 | / | / | / | / | 223 | 180 | / | / |
| 4 | -5 | 9 | / | / | / | / | 321 | 0 | / | / |
| 5 | -9 | 4 | / | / | / | / | 690 | 0 | / | / |
| 0 | 1 | 11 | / | / | / | / | 250 | 180 | / | / |
| 3 | -9 | 6 | / | / | / | / | 544 | 0 | / | / |
| 3 | -6 | 9 | / | / | / | / | 212 | 180 | / | / |
| 8 | 0 | -8 | 415 | 0 | 377 | 0 | 680 | 0 | 341 | 0 |
| 8 | -8 | 0 | / | / | / | / | 208 | 0 | / | / |
| 0 | 3 | -11 | / | / | / | / | 317 | 180 | / | / |
| 0 | 11 | -3 | / | / | / | / | 210 | 180 | / | / |
| 0 | 7 | 9 | / | / | / | / | 475 | 0 | / | / |
| 0 | 9 | 7 | / | / | / | / | 244 | 0 | / | / |
| 8 | -2 | -8 | / | / | / | / | 395 | 180 | / | / |
| 7 | -7 | -6 | / | / | / | / | 307 | 0 | / | / |
| 0 | 6 | -10 | / | / | / | / | 339 | 180 | / | / |
| 0 | 0 | 12 | / | / | / | / | 616 | 180 | 171 | 180 |
| 0 | 5 | -11 | / | / | / | / | 307 | 180 | / | / |
| 1 | -8 | 9 | / | / | / | / | 298 | 0 | / | / |
| 0 | 2 | 12 | / | / | / | / | 550 | 0 | / | / |
| 5 | -10 | -5 | / | / | / | / | 362 | 180 | / | / |
| 5 | -5 | -10 | / | / | / | / | 236 | 180 | / | / |
| 2 | -2 | -12 | / | / | / | / | 677 | 0 | / | / |
| 4 | -6 | 10 | / | / | / | / | 248 | 180 | / | / |
| 6 | -10 | 4 | / | / | / | / | 434 | 0 | / | / |
| 3 | -7 | 10 | / | / | / | / | 215 | 0 | / | / |
| 7 | -10 | 3 | / | / | / | / | 278 | 180 | / | / |
| 0 | 4 | 12 | / | / | / | / | 394 | 180 | / | / |
| 9 | 0 | -9 | / | / | / | / | 524 | 0 | 281 | 0 |
| 0 | 8 | -10 | / | / | / | / | 368 | 0 | / | / |
| 0 | 10 | -8 | / | / | / | / | 403 | 180 | / | / |
| 9 | -9 | -2 | / | / | / | / | 172 | 0 | / | / |
| 0 | 7 | -11 | / | / | / | / | 284 | 180 | / | / |
| 4 | -4 | -12 | / | / | / | / | 514 | 180 | / | / |
| 0 | 6 | -12 | / | / | / | / | 344 | 180 | / | / |
| 1 | -10 | 9 | / | / | / | / | 482 | 0 | / | / |
| 1 | -9 | -10 | / | / | / | / | 233 | 180 | / | / |
| 7 | -11 | 4 | / | / | / | / | 370 | 0 | / | / |
| 3 | -8 | 11 | / | / | / | / | 222 | 0 | / | / |
| 0 | 5 | 13 | / | / | / | / | 395 | 180 | / | / |
| 1 | -1 | -14 | / | / | / | / | 365 | 0 | / | / |
| 7 | -7 | -10 | / | / | / | / | 400 | 180 | / | / |
| 9 | -9 | -6 | / | / | / | / | 235 | 0 | / | / |
| 10 | -10 | 0 | / | / | / | / | 303 | 0 | / | / |
| 0 | 10 | -10 | / | / | / | / | 389 | 0 | / | / |
| 0 | 11 | -9 | / | / | / | / | 304 | 0 | / | / |
| 0 | 8 | -12 | / | / | / | / | 313 | 0 | / | / |
| 3 | -3 | -14 | / | / | / | / | 251 | 180 | / | / |
| 10 | -10 | -4 | / | / | / | / | 184 | 0 | / | / |
| 6 | -6 | -12 | / | / | / | / | 357 | 0 | / | / |
| 0 | 7 | 13 | / | / | / | / | 274 | 180 | / | / |
| 1 | -11 | 10 | / | / | / | / | 467 | 180 | / | / |
| 3 | -9 | -12 | / | / | / | / | 253 | 0 | / | / |
| 0 | 0 | 16 | / | / | / | / | 457 | 0 | / | / |
| 0 | 2 | 16 | / | / | / | / | 460 | 180 | / | / |
| 0 | 4 | 16 | / | / | / | / | 214 | 0 | / | / |
| 1 | -1 | -18 | / | / | / | / | 212 | 180 | / | / |
| 0 | 0 | 20 | / | / | / | / | 223 | 180 | / | / |

**Table S7.** Comparison of the phase residuals on phases *Φ*Res (the average phase errors in degrees) with amplitudes ≥ 2% of the largest amplitude.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Orientations** | **Plane group** | *Φ***Res (HAADF-STEM, 120 mm)** | *Φ***Res (HAADF-STEM, 100 mm)** | *Φ***Res (Underfocused)** | *Φ***Res (Infocused)** |
| [001] | *p*4*mm* | 4.8 | 4.6 | 6.0 | 10.7 |
| [101] | *p*2*mm* | 2.9 | 4.7 | 12.6 | 9.3 |
| [110] | *c*2*mm* | 7.1 | 9.0 | 9.5 | 5.4 |
| [111] | *c*2*mm* | 4.4 | 11.5 | 14.7 | 12.7 |
| [010] | *c*2*mm* | 6.6 | 6.2 | 13.3 | 12.3 |

The formula of *Φ*Res :

**Table S8.** Comparison of CSFs amplitudes before and after the CTF correction directly.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | **Underfocused TEM** | | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Corrected Amplitude** | **Phase** |
| 1 | 0 | -1 | 10000 | 10000 | 180 |
| 0 | 2 | 0 | 6171 | 2314 | 0 |
| 1 | -2 | -1 | 1879 | 513 | 180 |
| 1 | -1 | -2 | 1578 | 592 | 0 |
| 2 | -2 | 0 | 6575 | 1233 | 180 |
| 0 | 2 | -2 | 1736 | 434 | 180 |
| 0 | 1 | 3 | 1242 | 339 | 180 |
| 0 | 3 | 1 | 1009 | 159 | 180 |
| 1 | -3 | 2 | 1572 | 197 | 0 |
| 1 | -2 | 3 | 1100 | 174 | 0 |
| 2 | -3 | 1 | 1302 | 145 | 0 |
| 0 | 4 | 0 | 3259 | 306 | 0 |
| 0 | 0 | 4 | 2242 | 420 | 0 |
| 3 | 0 | -3 | 1603 | 178 | 0 |
| 1 | -4 | -1 | 421 | 36 | 0 |
| 4 | -2 | 0 | 256 | 19 | 0 |
| 0 | 2 | -4 | 1176 | 147 | 180 |
| 0 | 4 | -2 | 522 | 43 | 180 |
| 3 | -2 | -3 | 723 | 62 | 180 |
| 3 | -3 | -2 | 453 | 34 | 180 |
| 2 | -4 | -2 | 416 | 28 | 180 |
| 2 | -2 | -4 | 2159 | 202 | 180 |
| 0 | 1 | 5 | 2620 | 291 | 0 |
| 0 | 5 | 1 | 1250 | 74 | 0 |
| 1 | -4 | 3 | 1384 | 97 | 0 |
| 1 | -3 | 4 | 2160 | 180 | 0 |
| 3 | -4 | 1 | 1297 | 76 | 180 |
| 4 | -4 | 0 | 2613 | 123 | 180 |
| 0 | 4 | -4 | 1513 | 95 | 0 |
| 3 | -4 | -3 | 1280 | 65 | 180 |
| 0 | 3 | 5 | 1968 | 137 | 180 |
| 0 | 5 | -3 | 753 | 38 | 180 |
| 6 | 0 | 0 | 2219 | 92 | 0 |
| 4 | -2 | -4 | 476 | 26 | 180 |
| 1 | -6 | -1 | 938 | 38 | 0 |
| 1 | -1 | -6 | 915 | 69 | 0 |
| 2 | -5 | 3 | 1260 | 56 | 0 |
| 2 | -3 | 5 | 2956 | 174 | 0 |
| 3 | -5 | 2 | 412 | 17 | 0 |
| 6 | -2 | 0 | 1561 | 59 | 0 |
| 0 | 2 | -6 | 566 | 39 | 180 |
| 0 | 6 | -2 | 508 | 20 | 0 |
| 1 | -5 | 4 | 3442 | 152 | 180 |
| 1 | -4 | 5 | 3640 | 185 | 180 |
| 4 | -5 | -1 | 537 | 19 | 0 |
| 2 | -6 | -2 | 266 | 9 | 180 |
| 4 | -4 | -4 | 2013 | 76 | 180 |
| 5 | 0 | -5 | 1215 | 49 | 180 |
| 0 | 1 | 7 | 538 | 32 | 180 |
| 0 | 7 | 1 | 490 | 15 | 180 |
| 6 | -4 | 0 | 504 | 15 | 0 |
| 0 | 6 | -4 | 626 | 21 | 0 |
| 0 | 4 | -6 | 1658 | 73 | 180 |
| 5 | -2 | -5 | 554 | 20 | 0 |
| 3 | -6 | -3 | 804 | 24 | 0 |
| 3 | -3 | -6 | 1765 | 74 | 180 |
| 5 | -5 | -2 | 267 | 8 | 0 |
| 2 | -6 | 4 | 910 | 28 | 180 |
| 2 | -4 | 6 | 943 | 37 | 180 |
| 0 | 3 | -7 | 1147 | 51 | 0 |
| 0 | 7 | 3 | 336 | 9 | 0 |
| 1 | -6 | 5 | 2424 | 73 | 0 |
| 1 | -5 | -6 | 2278 | 78 | 180 |
| 5 | -6 | 1 | 840 | 20 | 180 |
| 0 | 8 | 0 | 467 | 11 | 0 |
| 0 | 0 | 8 | 580 | 27 | 180 |
| 5 | -4 | -5 | 762 | 21 | 180 |
| 8 | -2 | 0 | 315 | 7 | 0 |
| 0 | 2 | -8 | 406 | 17 | 180 |
|  | | | **Underfocused TEM** | | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Corrected Amplitude** | **Phase** |
| 4 | -6 | -4 | 394 | 10 | 180 |
| 6 | -6 | 0 | 596 | 12 | 180 |
| 6 | 0 | -6 | 977 | 27 | 180 |
| 0 | 5 | -7 | 1116 | 34 | 180 |
| 0 | 7 | -5 | 577 | 14 | 180 |
| 3 | -4 | 7 | 1319 | 40 | 0 |
| 4 | -7 | 3 | 394 | 9 | 180 |
| 6 | -2 | -6 | 468 | 12 | 0 |
| 2 | -5 | 7 | 884 | 25 | 180 |
| 8 | -4 | 0 | 425 | 8 | 0 |
| 0 | 4 | 8 | 857 | 27 | 0 |
| 0 | 8 | -4 | 441 | 9 | 0 |
| 3 | -8 | -3 | 378 | 7 | 0 |
| 0 | 1 | 9 | 529 | 19 | 180 |
| 0 | 9 | -1 | 395 | 7 | 0 |
| 5 | -5 | -6 | 382 | 8 | 180 |
| 1 | -7 | 6 | 238 | 5 | 180 |
| 1 | -6 | 7 | 399 | 10 | 180 |
| 6 | -7 | 1 | 706 | 12 | 180 |
| 6 | -6 | -4 | 703 | 13 | 180 |
| 0 | 3 | -9 | 446 | 14 | 180 |
| 7 | 0 | -7 | 684 | 14 | 0 |
| 3 | -8 | 5 | 762 | 13 | 180 |
| 3 | -5 | 8 | 767 | 17 | 0 |
| 0 | 10 | 0 | 479 | 7 | 0 |
| 8 | -6 | 0 | 251 | 4 | 0 |
| 0 | 6 | -8 | 490 | 11 | 0 |
| 0 | 8 | -6 | 576 | 11 | 0 |
| 1 | -1 | -10 | 567 | 16 | 180 |
| 7 | -7 | -2 | 282 | 4 | 0 |
| 10 | -2 | 0 | 208 | 3 | 180 |
| 0 | 2 | -10 | 260 | 7 | 180 |
| 2 | -8 | 6 | 583 | 10 | 0 |
| 2 | -6 | 8 | 730 | 15 | 0 |
| 0 | 5 | -9 | 406 | 9 | 180 |
| 0 | 9 | -5 | 550 | 9 | 180 |
| 5 | -8 | -5 | 268 | 4 | 180 |
| 1 | -8 | 7 | 677 | 11 | 180 |
| 1 | -7 | 8 | 608 | 11 | 180 |
| 0 | 10 | -4 | 303 | 4 | 0 |
| 0 | 4 | -10 | 496 | 11 | 0 |
| 3 | -10 | -3 | 223 | 3 | 180 |
| 3 | -3 | -10 | 661 | 15 | 0 |
| 4 | -5 | 9 | 321 | 6 | 0 |
| 5 | -9 | 4 | 690 | 9 | 0 |
| 0 | 1 | 11 | 250 | 6 | 180 |
| 3 | -9 | 6 | 544 | 8 | 0 |
| 3 | -6 | 9 | 212 | 4 | 180 |
| 8 | 0 | -8 | 680 | 11 | 0 |
| 8 | -8 | 0 | 208 | 2 | 0 |
| 0 | 3 | -11 | 317 | 7 | 180 |
| 0 | 11 | -3 | 210 | 3 | 180 |
| 0 | 7 | 9 | 475 | 8 | 0 |
| 0 | 9 | 7 | 244 | 3 | 0 |
| 8 | -2 | -8 | 395 | 6 | 180 |
| 7 | -7 | -6 | 307 | 4 | 0 |
| 0 | 6 | -10 | 339 | 6 | 180 |
| 0 | 0 | 12 | 616 | 13 | 180 |
| 0 | 5 | -11 | 307 | 5 | 180 |
| 1 | -8 | 9 | 298 | 4 | 0 |
| 0 | 2 | 12 | 550 | 11 | 0 |
| 5 | -10 | -5 | 362 | 4 | 180 |
| 5 | -5 | -10 | 236 | 4 | 180 |
| 2 | -2 | -12 | 677 | 13 | 0 |
| 4 | -6 | 10 | 248 | 4 | 180 |
| 6 | -10 | 4 | 434 | 5 | 0 |
| 3 | -7 | 10 | 215 | 3 | 0 |
| 7 | -10 | 3 | 278 | 3 | 180 |
| 0 | 4 | 12 | 394 | 7 | 180 |
| 9 | 0 | -9 | 524 | 6 | 0 |
| 0 | 8 | -10 | 368 | 5 | 0 |
| 0 | 10 | -8 | 403 | 5 | 180 |
| 9 | -9 | -2 | 172 | 2 | 0 |
| 0 | 7 | -11 | 284 | 4 | 180 |
| 4 | -4 | -12 | 514 | 7 | 180 |
| 0 | 6 | -12 | 344 | 5 | 180 |
| 1 | -10 | 9 | 482 | 5 | 0 |
| 1 | -9 | -10 | 233 | 3 | 180 |
| 7 | -11 | 4 | 370 | 3 | 0 |
| 3 | -8 | 11 | 222 | 3 | 0 |
| 0 | 5 | 13 | 373 | 5 | 180 |
| 1 | -1 | -14 | 340 | 5 | 0 |
| 7 | -7 | -10 | 372 | 4 | 180 |
| 9 | -9 | -6 | 219 | 2 | 0 |
| 10 | -10 | 0 | 281 | 2 | 0 |
| 0 | 10 | -10 | 340 | 3 | 0 |
| 0 | 11 | -9 | 266 | 2 | 0 |
| 0 | 8 | -12 | 274 | 3 | 0 |
|  | | | **Underfocused TEM** | | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Corrected Amplitude** | **Phase** |
| 3 | -3 | -14 | 233 | 3 | 180 |
| 10 | -10 | -4 | 171 | 1 | 0 |
| 6 | -6 | -12 | 312 | 3 | 0 |
| 0 | 7 | 13 | 259 | 3 | 180 |
| 1 | -11 | 10 | 409 | 4 | 180 |
| 3 | -9 | -12 | 221 | 2 | 0 |
| 0 | 0 | 16 | 638 | 7 | 0 |
| 0 | 2 | 16 | 428 | 5 | 180 |
| 0 | 4 | 16 | 199 | 2 | 0 |
| 1 | -1 | -18 | 197 | 2 | 180 |
| 0 | 0 | 20 | 208 | 2 | 180 |

The formula and parameters for calculating the CTF were as follows:

Where spherical aberration (Cs) = 1.0 mm, = 0.0251 Å, ∆*f* = -5000 Å (which is close to the experimental condition for taking the TEM images) and *u* is a positional vector in reciprocal space.

The formula for calculating the CTF correction directly was as follows:

Where *F* is the amplitude of CSFs.

The formula for calculating the estimated CTF correction through a Wiener filter was as follows:

Where constant = 6 × 10−6.

图表, 折线图

描述已自动生成

**Fig. S5.** A series of sin( curves calculated for different values of ∆*f*. (**a**)∆*f* = -7000 Å, (**b**) ∆*f* = -5000 Å, (**c**) ∆*f* = -2000 Å, (**d**) at Scherzer defocus ∆*f* = -425 Å.

**Table S9.** Comparison of CSFs amplitudes before and after the estimated CTF correction through a Wiener filter.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | | | **Underfocused TEM** | | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Corrected Amplitude** | **Phase** |
| 1 | 0 | -1 | 10000 | 10000 | 180 |
| 0 | 2 | 0 | 6171 | 7576 | 0 |
| 1 | -2 | -1 | 1879 | 2035 | 180 |
| 1 | -1 | -2 | 1578 | 1937 | 0 |
| 2 | -2 | 0 | 6575 | 5598 | 180 |
| 0 | 2 | -2 | 1736 | 1791 | 180 |
| 0 | 1 | 3 | 1242 | 1345 | 180 |
| 0 | 3 | 1 | 1009 | 752 | 180 |
| 1 | -3 | 2 | 1572 | 961 | 0 |
| 1 | -2 | 3 | 1100 | 820 | 0 |
| 2 | -3 | 1 | 1302 | 717 | 0 |
| 0 | 4 | 0 | 3259 | 1536 | 0 |
| 0 | 0 | 4 | 2242 | 1909 | 0 |
| 3 | 0 | -3 | 1603 | 883 | 0 |
| 1 | -4 | -1 | 421 | 183 | 0 |
| 4 | -2 | 0 | 256 | 98 | 0 |
| 0 | 2 | -4 | 1176 | 719 | 180 |
| 0 | 4 | -2 | 522 | 220 | 180 |
| 3 | -2 | -3 | 723 | 313 | 180 |
| 3 | -3 | -2 | 453 | 173 | 180 |
| 2 | -4 | -2 | 416 | 145 | 180 |
| 2 | -2 | -4 | 2159 | 1018 | 180 |
| 0 | 1 | 5 | 2620 | 1443 | 0 |
| 0 | 5 | 1 | 1250 | 378 | 0 |
| 1 | -4 | 3 | 1384 | 493 | 0 |
| 1 | -3 | 4 | 2160 | 912 | 0 |
| 3 | -4 | 1 | 1297 | 392 | 180 |
| 4 | -4 | 0 | 2613 | 633 | 180 |
| 0 | 4 | -4 | 1513 | 485 | 0 |
| 3 | -4 | -3 | 1280 | 336 | 180 |
| 0 | 3 | 5 | 1968 | 702 | 180 |
| 0 | 5 | -3 | 753 | 198 | 180 |
| 6 | 0 | 0 | 2219 | 479 | 0 |
| 4 | -2 | -4 | 476 | 131 | 180 |
| 1 | -6 | -1 | 938 | 194 | 0 |
| 1 | -1 | -6 | 915 | 350 | 0 |
| 2 | -5 | 3 | 1260 | 292 | 0 |
| 2 | -3 | 5 | 2956 | 894 | 0 |
| 3 | -5 | 2 | 412 | 89 | 0 |
| 6 | -2 | 0 | 1561 | 304 | 0 |
| 0 | 2 | -6 | 566 | 197 | 180 |
| 0 | 6 | -2 | 508 | 104 | 0 |
| 1 | -5 | 4 | 3442 | 785 | 180 |
| 1 | -4 | 5 | 3640 | 955 | 180 |
| 4 | -5 | -1 | 537 | 101 | 0 |
| 2 | -6 | -2 | 266 | 49 | 180 |
| 4 | -4 | -4 | 2013 | 391 | 180 |
| 5 | 0 | -5 | 1215 | 252 | 180 |
| 0 | 1 | 7 | 538 | 163 | 180 |
| 0 | 7 | 1 | 490 | 77 | 180 |
| 6 | -4 | 0 | 504 | 75 | 0 |
| 0 | 6 | -4 | 626 | 111 | 0 |
| 0 | 4 | -6 | 1658 | 378 | 180 |
| 5 | -2 | -5 | 554 | 104 | 0 |
| 3 | -6 | -3 | 804 | 127 | 0 |
| 3 | -3 | -6 | 1765 | 381 | 180 |
| 5 | -5 | -2 | 267 | 40 | 0 |
| 2 | -6 | 4 | 910 | 148 | 180 |
| 2 | -4 | 6 | 943 | 193 | 180 |
| 0 | 3 | -7 | 1147 | 266 | 0 |
| 0 | 7 | 3 | 336 | 49 | 0 |
| 1 | -6 | 5 | 2424 | 382 | 0 |
| 1 | -5 | -6 | 2278 | 403 | 180 |
| 5 | -6 | 1 | 840 | 107 | 180 |
| 0 | 8 | 0 | 467 | 57 | 0 |
| 0 | 0 | 8 | 580 | 141 | 180 |
| 5 | -4 | -5 | 762 | 111 | 180 |
| 8 | -2 | 0 | 315 | 36 | 0 |
| 0 | 2 | -8 | 406 | 88 | 180 |
| 4 | -6 | -4 | 394 | 51 | 180 |
| 6 | -6 | 0 | 596 | 65 | 180 |
| 6 | 0 | -6 | 977 | 141 | 180 |
| 0 | 5 | -7 | 1116 | 176 | 180 |
| 0 | 7 | -5 | 577 | 73 | 180 |
| 3 | -4 | 7 | 1319 | 208 | 0 |
| 4 | -7 | 3 | 394 | 44 | 180 |
| 6 | -2 | -6 | 468 | 63 | 0 |
| 2 | -5 | 7 | 884 | 129 | 180 |
| 8 | -4 | 0 | 425 | 41 | 0 |
| 0 | 4 | 8 | 857 | 139 | 0 |
| 0 | 8 | -4 | 441 | 48 | 0 |
| 3 | -8 | -3 | 378 | 38 | 0 |
| 0 | 1 | 9 | 529 | 99 | 180 |
| 0 | 9 | -1 | 395 | 38 | 0 |
| 5 | -5 | -6 | 382 | 44 | 180 |
| 1 | -7 | 6 | 238 | 27 | 180 |
|  | | | **Underfocused TEM** | | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Corrected Amplitude** | **Phase** |
| 1 | -6 | 7 | 399 | 51 | 180 |
| 6 | -7 | 1 | 706 | 65 | 180 |
| 6 | -6 | -4 | 703 | 69 | 180 |
| 0 | 3 | -9 | 446 | 70 | 180 |
| 7 | 0 | -7 | 684 | 73 | 0 |
| 3 | -8 | 5 | 762 | 70 | 180 |
| 3 | -5 | 8 | 767 | 91 | 0 |
| 0 | 10 | 0 | 479 | 37 | 0 |
| 8 | -6 | 0 | 251 | 20 | 0 |
| 0 | 6 | -8 | 490 | 56 | 0 |
| 0 | 8 | -6 | 576 | 55 | 0 |
| 1 | -1 | -10 | 567 | 85 | 180 |
| 7 | -7 | -2 | 282 | 22 | 0 |
| 10 | -2 | 0 | 208 | 16 | 180 |
| 0 | 2 | -10 | 260 | 37 | 180 |
| 2 | -8 | 6 | 583 | 53 | 0 |
| 2 | -6 | 8 | 730 | 79 | 0 |
| 0 | 5 | -9 | 406 | 48 | 180 |
| 0 | 9 | -5 | 550 | 46 | 180 |
| 5 | -8 | -5 | 268 | 21 | 180 |
| 1 | -8 | 7 | 677 | 59 | 180 |
| 1 | -7 | 8 | 608 | 58 | 180 |
| 0 | 10 | -4 | 303 | 22 | 0 |
| 0 | 4 | -10 | 496 | 59 | 0 |
| 3 | -10 | -3 | 223 | 15 | 180 |
| 3 | -3 | -10 | 661 | 76 | 0 |
| 4 | -5 | 9 | 321 | 31 | 0 |
| 5 | -9 | 4 | 690 | 47 | 0 |
| 0 | 1 | 11 | 250 | 32 | 180 |
| 3 | -9 | 6 | 544 | 39 | 0 |
| 3 | -6 | 9 | 212 | 19 | 180 |
| 8 | 0 | -8 | 680 | 55 | 0 |
| 8 | -8 | 0 | 208 | 13 | 0 |
| 0 | 3 | -11 | 317 | 36 | 180 |
| 0 | 11 | -3 | 210 | 13 | 180 |
| 0 | 7 | 9 | 475 | 42 | 0 |
| 0 | 9 | 7 | 244 | 18 | 0 |
| 8 | -2 | -8 | 395 | 31 | 180 |
| 7 | -7 | -6 | 307 | 21 | 0 |
| 0 | 6 | -10 | 339 | 31 | 180 |
| 0 | 0 | 12 | 616 | 67 | 180 |
| 0 | 5 | -11 | 307 | 28 | 180 |
| 1 | -8 | 9 | 298 | 22 | 0 |
| 0 | 2 | 12 | 550 | 57 | 0 |
| 5 | -10 | -5 | 362 | 21 | 180 |
| 5 | -5 | -10 | 236 | 18 | 180 |
| 2 | -2 | -12 | 677 | 66 | 0 |
| 4 | -6 | 10 | 248 | 19 | 180 |
| 6 | -10 | 4 | 434 | 24 | 0 |
| 3 | -7 | 10 | 215 | 16 | 0 |
| 7 | -10 | 3 | 278 | 14 | 180 |
| 0 | 4 | 12 | 394 | 35 | 180 |
| 9 | 0 | -9 | 524 | 34 | 0 |
| 0 | 8 | -10 | 368 | 25 | 0 |
| 0 | 10 | -8 | 403 | 24 | 180 |
| 9 | -9 | -2 | 172 | 8 | 0 |
| 0 | 7 | -11 | 284 | 20 | 180 |
| 4 | -4 | -12 | 514 | 39 | 180 |
| 0 | 6 | -12 | 344 | 25 | 180 |
| 1 | -10 | 9 | 482 | 27 | 0 |
| 1 | -9 | -10 | 233 | 14 | 180 |
| 7 | -11 | 4 | 370 | 16 | 0 |
| 3 | -8 | 11 | 222 | 13 | 0 |
| 0 | 5 | 13 | 373 | 27 | 180 |
| 1 | -1 | -14 | 340 | 27 | 0 |
| 7 | -7 | -10 | 372 | 20 | 180 |
| 9 | -9 | -6 | 219 | 10 | 0 |
| 10 | -10 | 0 | 281 | 11 | 0 |
| 0 | 10 | -10 | 340 | 18 | 0 |
| 0 | 11 | -9 | 266 | 13 | 0 |
| 0 | 8 | -12 | 274 | 16 | 0 |
| 3 | -3 | -14 | 233 | 16 | 180 |
| 10 | -10 | -4 | 171 | 6 | 0 |
| 6 | -6 | -12 | 312 | 17 | 0 |
| 0 | 7 | 13 | 259 | 15 | 180 |
| 1 | -11 | 10 | 409 | 19 | 180 |
| 3 | -9 | -12 | 221 | 11 | 0 |
| 0 | 0 | 16 | 638 | 39 | 0 |
| 0 | 2 | 16 | 428 | 25 | 180 |
| 0 | 4 | 16 | 199 | 11 | 0 |
| 1 | -1 | -18 | 197 | 9 | 180 |
| 0 | 0 | 20 | 208 | 8 | 180 |

**Table S10.** Comparison of CSFs extracted from HAADF-STEM (120 mm) images and calculated from the software MesoPoreImage. The amplitudes are scaled based on the strongest amplitude. The phases different from HAADF-STEM (120 mm) are marked red color.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | | | **HAADF-STEM, 120 mm** | | **MesoPoreImage** | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Phase** | **Amplitude** | **Phase** |
| 1 | 0 | -1 | 10000 | 0 | 10000 | 0 |
| 2 | -2 | 0 | 4614 | 0 | 8311 | 0 |
| 0 | 0 | 4 | 1643 | 180 | 7015 | 180 |
| 0 | 2 | -4 | 644 | 0 | 3906 | 0 |
| 4 | -4 | 0 | 1044 | 0 | 3518 | 0 |
| 0 | 6 | -4 | 238 | 180 | 3296 | 180 |
| 1 | -3 | 4 | 940 | 180 | 3230 | 180 |
| 1 | -2 | -1 | 1524 | 0 | 3171 | 0 |
| 0 | 5 | -3 | 357 | 0 | 2691 | 0 |
| 1 | -4 | 5 | 1333 | 0 | 2663 | 0 |
| 0 | 2 | 0 | 4456 | 180 | 2621 | 180 |
| 5 | 0 | -5 | 538 | 0 | 2560 | 0 |
| 0 | 0 | 8 | 414 | 0 | 2531 | 0 |
| 5 | -3 | -4 | / | / | 2485 | 0 |
| 6 | -2 | 0 | 767 | 180 | 2449 | 180 |
| 2 | -2 | -4 | 1011 | 0 | 2396 | 0 |
| 0 | 4 | 0 | 1810 | 180 | 2297 | 180 |
| 1 | -4 | 3 | 551 | 180 | 2218 | 180 |
| 3 | -4 | 1 | 493 | 0 | 2188 | 0 |
| 0 | 1 | 3 | 662 | 0 | 2146 | 0 |
| 1 | 3 | -8 | / | / | 2034 | 0 |
| -2 | -2 | 8 | / | / | 2033 | 180 |
| 2 | -3 | 1 | 688 | 180 | 2031 | 180 |
| 0 | 2 | 8 | 114 | 180 | 2019 | 180 |
| 4 | -4 | -4 | 853 | 0 | 1990 | 0 |
| 5 | -2 | 1 | / | / | 1977 | 180 |
| 0 | 6 | 0 | 973 | 0 | 1931 | 0 |
| 0 | 3 | -5 | 1078 | 180 | 1827 | 180 |
| 2 | -3 | 5 | 1242 | 180 | 1826 | 180 |
| 3 | 0 | -3 | 899 | 180 | 1807 | 180 |
| 4 | -2 | 0 | 174 | 180 | 1697 | 180 |
| 0 | 5 | 1 | 863 | 180 | 1679 | 180 |
| 3 | -4 | -3 | 566 | 0 | 1512 | 0 |
| 0 | -1 | -7 | / | / | 1475 | 180 |
| 0 | 1 | 5 | 1074 | 180 | 1457 | 180 |
| 0 | 4 | -4 | 495 | 180 | 1440 | 0 |
| 1 | -2 | 7 | / | / | 1330 | 180 |
| 1 | -5 | 4 | 1016 | 0 | 1263 | 0 |
| 0 | 3 | 1 | 491 | 0 | 1086 | 0 |
| 6 | -2 | 4 | / | / | 967 | 0 |
| 1 | -1 | -2 | 1562 | 180 | 929 | 180 |
| 5 | -2 | -5 | 289 | 180 | 719 | 180 |
| 1 | -1 | -6 | 622 | 180 | 660 | 0 |
| -6 | 1 | 3 | / | / | 654 | 180 |
| -4 | -1 | -7 | / | / | 634 | 180 |
| 0 | 4 | 8 | 312 | 180 | 545 | 180 |
| 0 | 4 | -6 | 650 | 0 | 512 | 180 |
| 1 | -2 | 3 | 773 | 180 | 506 | 0 |
| 5 | 1 | 2 | / | / | 396 | 0 |
| 1 | -5 | -6 | 700 | 0 | 363 | 180 |
| 2 | -5 | 3 | / | / | 359 | 180 |
| 3 | -3 | -2 | 186 | 0 | 342 | 180 |
| 4 | -2 | -4 | 268 | 0 | 317 | 180 |
| -5 | -3 | 2 | / | / | 311 | 0 |
| 3 | -2 | -3 | 365 | 0 | 310 | 0 |
| 0 | 2 | -6 | 319 | 0 | 296 | 0 |
| 0 | 1 | 9 | 214 | 0 | 281 | 180 |
| 2 | -4 | 6 | 366 | 0 | 273 | 180 |
| 0 | 3 | -7 | 433 | 180 | 269 | 180 |
| 1 | -6 | -1 | 381 | 180 | 266 | 180 |
| 4 | -5 | 1 | / | / | 233 | 180 |
| 0 | 4 | -2 | 339 | 0 | 220 | 0 |
| -5 | 4 | -3 | / | / | 214 | 180 |
| -2 | -3 | 7 | / | / | 213 | 180 |
| 4 | -1 | 1 | / | / | 173 | 180 |
| -4 | -3 | 5 | / | / | 157 | 180 |
| 2 | -1 | -9 | / | / | 152 | 180 |
| 0 | 2 | -2 | 1109 | 0 | 130 | 180 |
| 3 | -3 | -6 | 644 | 0 | 117 | 0 |
| 2 | -4 | -2 | 230 | 0 | 112 | 0 |
| 1 | -3 | 6 | / | / | 50 | 0 |
| 0 | 6 | 2 | 305 | 180 | 43 | 180 |
| 1 | 2 | -5 | / | / | 41 | 180 |
| 6 | 3 | -1 | / | / | 31 | 180 |
| 1 | -3 | 2 | 921 | 180 | 20 | 180 |
| 2 | 6 | -2 | / | / | 6 | 0 |
| 0 | 7 | 1 | 224 | 0 | / | / |
| 6 | -4 | 0 | 214 | 180 | / | / |
| 3 | -6 | -3 | 292 | 180 | / | / |
| 1 | -6 | 5 | 547 | 180 | / | / |
| 0 | 8 | 0 | 237 | 180 | / | / |
| 5 | -4 | -5 | 356 | 0 | / | / |
| 8 | -2 | 0 | 198 | 180 | / | / |
| 4 | -6 | -4 | 201 | 0 | / | / |
| 6 | -6 | 0 | 255 | 0 | / | / |
| 6 | 0 | -6 | 412 | 0 | / | / |
|  | | | **HAADF-STEM, 120 mm** | | **MesoPoreImage** | |
| ***h*** | ***k*** | ***l*** | **Amplitude** | **Phase** | **Amplitude** | **Phase** |
| 0 | 5 | -7 | 386 | 0 | / | / |
| 3 | -4 | 7 | 421 | 180 | / | / |
| 0 | 7 | 5 | 324 | 180 | / | / |
| 6 | -2 | -6 | 233 | 180 | / | / |
| 2 | -5 | 7 | 266 | 0 | / | / |
| 8 | -4 | 0 | 216 | 180 | / | / |
| 5 | -5 | -6 | 134 | 0 | / | / |
| 6 | -6 | -4 | 200 | 0 | / | / |
| 0 | 3 | 9 | 222 | 180 | / | / |
| 7 | 0 | -7 | 393 | 0 | / | / |
| 3 | -5 | 8 | 236 | 180 | / | / |
| 0 | 8 | 6 | 202 | 0 | / | / |
| 1 | -1 | -10 | 159 | 180 | / | / |
| 3 | -3 | -10 | 207 | 0 | / | / |
| 8 | 0 | -8 | 415 | 180 | / | / |