# Supplementary Information:

## Using ratiometric indicator-displacement assays in semi-quantitatively colorimetric determination of chloride, bromide, and iodide anions

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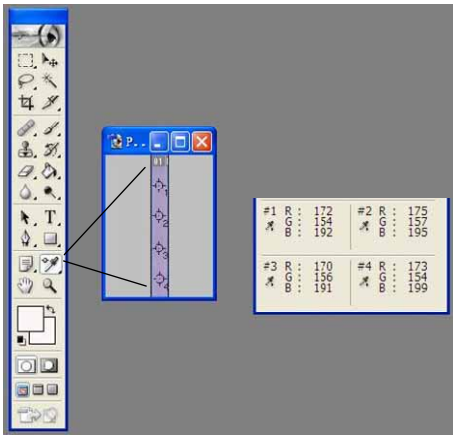


***Fig. S1*** The colour sampler function in Adobe Photshop software package was used to collect red, green and blue values of scanned supernant liquid images.

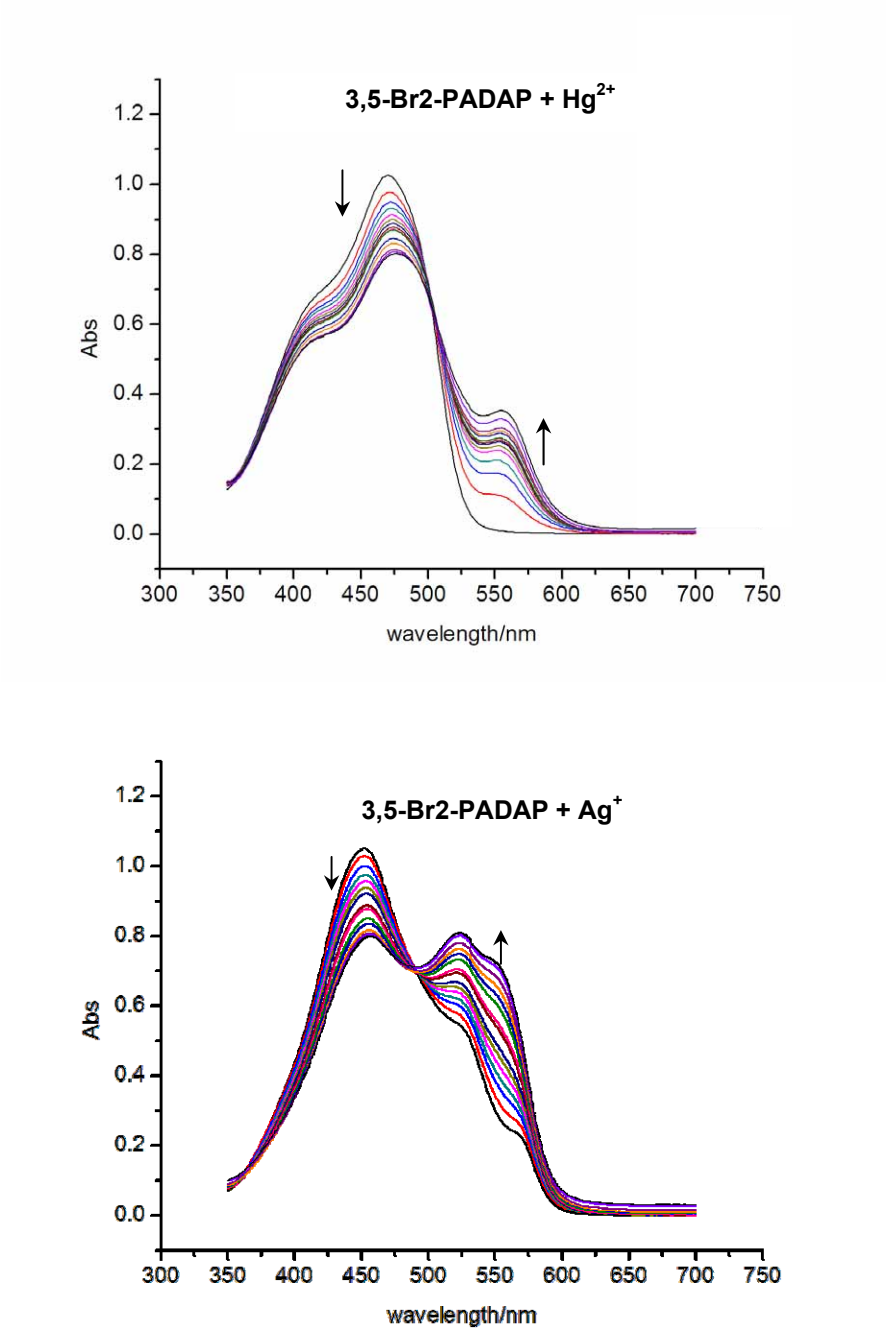


***Fig. S2*** The titration curves of 3,5-Br2-PADAP and metal receptor $Hg^{2+}$ and $Ag^{+}$ cations. (The 3,5-Br2-PADAP concentration was $2.5x10^{-5}$ mol/L for both of the curves)

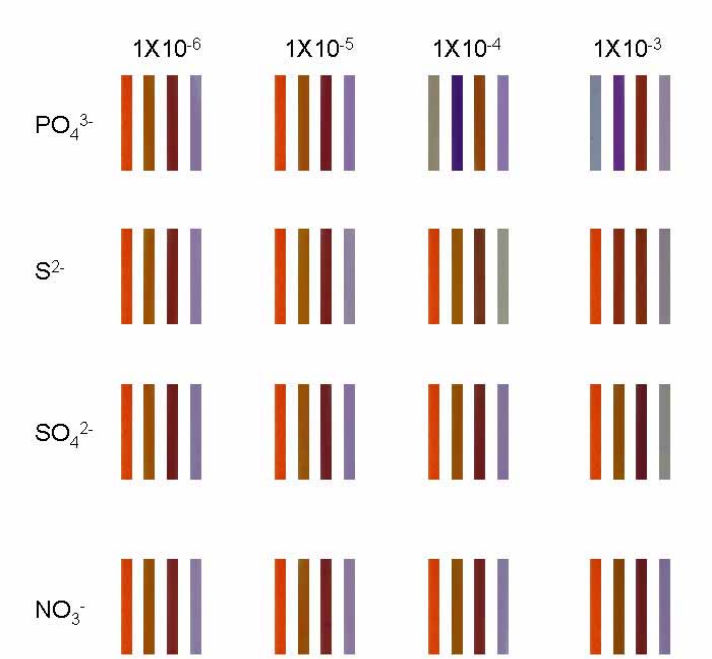


***Fig. S3*** The RIDA responses to different interfering anions at various concentrations.

***Table S1.*** The solubility product constants ($K_{sp}$) of silver and mercuric cations with chloride, bromide, and iodide anions.

| | Ag | Hg |
|---|---|---|
| $Cl^-$ | $1.923\times10^{-4}$ | 6.57 |
| $Br^-$ | $1.328\times10^{-5}$ | 0.56 |
| $I^-$ | $3\times10^{-7}$ | $6\times10^{-3}$ |

***Table S2***. Full digital database (R=red, G=green, B=blue values) of RIDA array after reacting with chloride, bromide, and iodide.

| | | | D-11-Ag | | | | | | D-11-Hg | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0.0001 M | | | 0.00001 M | | | 0.0001 M | | | 0.00001 M | | |
| | | | R | G | B | R | G | B | R | G | B | R | G | B |
| Cl- | 0 | Trial_1 | 213 | 64 | 8 | 215 | 103 | 1 | 157 | 40 | 5 | 195 | 140 | 192 |
| | | Trial_2 | 215 | 63 | 6 | 212 | 100 | 0 | 158 | 42 | 7 | 194 | 143 | 193 |
| | | Trial_3 | 215 | 61 | 5 | 214 | 99 | 1 | 160 | 39 | 8 | 192 | 142 | 190 |
| | | Trial_4 | 210 | 59 | 7 | 210 | 101 | 1 | 158 | 38 | 9 | 193 | 142 | 191 |
| | | Trial_5 | 207 | 59 | 6 | 213 | 101 | 0 | 165 | 36 | 10 | 195 | 140 | 193 |
| | 1.00E-05 | Trial_1 | 208 | 47 | 0 | 216 | 106 | 0 | 149 | 38 | 8 | 192 | 141 | 190 |
| | | Trial_2 | 211 | 50 | 0 | 212 | 106 | 1 | 152 | 35 | 10 | 190 | 139 | 185 |
| | | Trial_3 | 203 | 43 | 1 | 212 | 107 | 1 | 150 | 40 | 10 | 185 | 137 | 186 |
| | | Trial_4 | 208 | 49 | 1 | 213 | 109 | 1 | 150 | 37 | 10 | 192 | 139 | 191 |
| | | Trial_5 | 211 | 47 | 0 | 215 | 109 | 1 | 150 | 39 | 10 | 188 | 138 | 186 |
| | 5.00E-05 | Trial_1 | 210 | 57 | 1 | 213 | 114 | 0 | 146 | 39 | 9 | 189 | 149 | 188 |
| | | Trial_2 | 209 | 58 | 1 | 209 | 104 | 1 | 140 | 38 | 8 | 192 | 148 | 186 |
| | | Trial_3 | 210 | 57 | 1 | 209 | 106 | 1 | 140 | 36 | 10 | 189 | 145 | 185 |
| | | Trial_4 | 210 | 56 | 1 | 207 | 114 | 1 | 144 | 39 | 9 | 188 | 146 | 188 |
| | | Trial_5 | 210 | 58 | 1 | 210 | 111 | 1 | 142 | 38 | 9 | 189 | 144 | 183 |
| | 1.00E-04 | Trial_1 | 208 | 62 | 1 | 213 | 111 | 1 | 155 | 33 | 9 | 199 | 155 | 189 |
| | | Trial_2 | 206 | 60 | 1 | 208 | 111 | 1 | 156 | 31 | 8 | 196 | 151 | 189 |
| | | Trial_3 | 206 | 62 | 1 | 206 | 103 | 1 | 151 | 28 | 10 | 190 | 148 | 183 |
| | | Trial_4 | 207 | 63 | 0 | 211 | 107 | 1 | 152 | 26 | 8 | 189 | 146 | 182 |
| | | Trial_5 | 208 | 65 | 0 | 205 | 111 | 1 | 153 | 28 | 9 | 190 | 149 | 183 |
| | 5.00E-04 | Trial_1 | 209 | 80 | 1 | 213 | 111 | 0 | 171 | 46 | 5 | 203 | 163 | 174 |
| | | Trial_2 | 210 | 82 | 0 | 212 | 111 | 0 | 173 | 42 | 6 | 195 | 161 | 170 |
| | | Trial_3 | 211 | 83 | 1 | 216 | 111 | 1 | 164 | 40 | 6 | 204 | 163 | 173 |
| | | Trial_4 | 209 | 88 | 2 | 212 | 109 | 0 | 164 | 46 | 6 | 205 | 163 | 173 |
| | | Trial_5 | 209 | 89 | 2 | 210 | 109 | 1 | 168 | 49 | 6 | 197 | 160 | 171 |
| | 1.00E-03 | Trial_1 | 215 | 83 | 1 | 211 | 110 | 1 | 165 | 44 | 8 | 195 | 171 | 171 |
| | | Trial_2 | 211 | 84 | 1 | 210 | 110 | 0 | 164 | 44 | 8 | 199 | 170 | 169 |
| | | Trial_3 | 215 | 85 | 0 | 212 | 111 | 1 | 166 | 42 | 10 | 200 | 163 | 166 |
| | | Trial_4 | 215 | 83 | 1 | 215 | 111 | 1 | 166 | 43 | 10 | 199 | 162 | 162 |
| | | Trial_5 | 211 | 82 | 1 | 214 | 112 | 1 | 169 | 40 | 8 | 199 | 164 | 163 |
| | 5.00E-03 | Trial_1 | 216 | 93 | 1 | 215 | 115 | 2 | 178 | 52 | 6 | 200 | 174 | 154 |
| | | Trial_2 | 211 | 88 | 1 | 214 | 111 | 1 | 180 | 50 | 3 | 203 | 170 | 152 |
| | | Trial_3 | 210 | 82 | 0 | 211 | 111 | 1 | 179 | 43 | 4 | 203 | 173 | 153 |
| | | Trial_4 | 213 | 85 | 1 | 206 | 110 | 1 | 177 | 43 | 5 | 200 | 173 | 151 |
| | | Trial_5 | 214 | 88 | 1 | 214 | 112 | 1 | 180 | 45 | 4 | 201 | 170 | 153 |
| | 1.00E-02 | Trial_1 | 213 | 95 | 0 | 214 | 112 | 2 | 174 | 50 | 4 | 208 | 181 | 151 |
| | | Trial_2 | 211 | 92 | 1 | 209 | 106 | 2 | 169 | 46 | 4 | 202 | 180 | 151 |
| | | Trial_3 | 214 | 91 | 1 | 210 | 111 | 1 | 172 | 51 | 5 | 202 | 176 | 150 |
| | | Trial_4 | 206 | 90 | 1 | 212 | 108 | 1 | 173 | 44 | 2 | 201 | 178 | 153 |
| | | Trial_5 | 209 | 89 | 1 | 216 | 109 | 2 | 170 | 48 | 4 | 204 | 180 | 151 |

| | | | D-11-Ag | | | | | | D-11-Hg | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0.0001 M | | | 0.00001 M | | | 0.0001 M | | | 0.00001 M | | |
| | | | R | G | B | R | G | B | R | G | B | R | G | B |
| Br- | 0 | Trial_1 | 213 | 64 | 8 | 206 | 98 | 1 | 157 | 65 | 34 | 167 | 153 | 189 |
| | | Trial_2 | 215 | 63 | 6 | 210 | 102 | 1 | 156 | 58 | 29 | 168 | 171 | 191 |
| | | Trial_3 | 215 | 61 | 5 | 211 | 97 | 0 | 157 | 58 | 29 | 169 | 154 | 190 |
| | | Trial_4 | 210 | 59 | 7 | 212 | 101 | 1 | 159 | 58 | 28 | 170 | 155 | 191 |
| | | Trial_5 | 207 | 59 | 6 | 216 | 100 | 0 | 162 | 62 | 30 | 172 | 168 | 195 |
| | 1.00E-05 | Trial_1 | 204 | 60 | 11 | 191 | 103 | 2 | 163 | 68 | 34 | 177 | 165 | 197 |
| | | Trial_2 | 204 | 62 | 7 | 191 | 99 | 1 | 168 | 68 | 34 | 178 | 165 | 197 |
| | | Trial_3 | 200 | 66 | 10 | 193 | 103 | 2 | 166 | 66 | 32 | 180 | 165 | 198 |
| | | Trial_4 | 197 | 66 | 12 | 193 | 105 | 2 | 165 | 65 | 29 | 182 | 171 | 202 |
| | | Trial_5 | 197 | 65 | 12 | 197 | 99 | 1 | 168 | 66 | 31 | 182 | 174 | 203 |
| | 5.00E-05 | Trial_1 | 203 | 75 | 8 | 180 | 108 | 4 | 167 | 75 | 32 | 176 | 160 | 181 |
| | | Trial_2 | 199 | 78 | 11 | 181 | 107 | 4 | 167 | 71 | 29 | 177 | 156 | 178 |
| | | Trial_3 | 196 | 74 | 8 | 182 | 108 | 5 | 166 | 65 | 27 | 179 | 155 | 178 |
| | | Trial_4 | 192 | 76 | 10 | 185 | 106 | 2 | 169 | 70 | 32 | 179 | 159 | 180 |
| | | Trial_5 | 190 | 76 | 11 | 188 | 107 | 3 | 168 | 70 | 30 | 181 | 162 | 183 |
| | 1.00E-04 | Trial_1 | 205 | 77 | 4 | 204 | 111 | 1 | 167 | 75 | 30 | 176 | 161 | 165 |
| | | Trial_2 | 203 | 78 | 4 | 203 | 114 | 2 | 166 | 68 | 25 | 175 | 158 | 162 |
| | | Trial_3 | 197 | 78 | 6 | 204 | 107 | 0 | 168 | 74 | 30 | 176 | 156 | 159 |
| | | Trial_4 | 195 | 73 | 3 | 203 | 113 | 2 | 168 | 71 | 28 | 178 | 161 | 163 |
| | | Trial_5 | 193 | 71 | 3 | 201 | 113 | 2 | 168 | 66 | 26 | 178 | 163 | 164 |
| | 5.00E-04 | Trial_1 | 206 | 108 | 2 | 193 | 113 | 4 | 190 | 85 | 8 | 187 | 168 | 167 |
| | | Trial_2 | 206 | 101 | 1 | 194 | 110 | 3 | 192 | 89 | 9 | 188 | 166 | 164 |
| | | Trial_3 | 205 | 101 | 2 | 194 | 111 | 4 | 191 | 85 | 8 | 188 | 170 | 163 |
| | | Trial_4 | 203 | 104 | 2 | 195 | 110 | 2 | 192 | 82 | 7 | 189 | 168 | 163 |
| | | Trial_5 | 204 | 108 | 2 | 197 | 113 | 3 | 191 | 82 | 8 | 189 | 170 | 161 |
| | 1.00E-03 | Trial_1 | 207 | 105 | 0 | 190 | 106 | 2 | 196 | 87 | 13 | 182 | 167 | 159 |
| | | Trial_2 | 202 | 110 | 2 | 190 | 110 | 5 | 188 | 87 | 13 | 187 | 169 | 160 |
| | | Trial_3 | 201 | 112 | 6 | 192 | 111 | 5 | 192 | 83 | 11 | 186 | 165 | 154 |
| | | Trial_4 | 199 | 111 | 4 | 195 | 109 | 2 | 194 | 84 | 11 | 185 | 166 | 155 |
| | | Trial_5 | 198 | 108 | 3 | 196 | 107 | 1 | 194 | 73 | 12 | 186 | 168 | 157 |
| | 5.00E-03 | Trial_1 | 207 | 107 | 1 | 194 | 107 | 2 | 185 | 95 | 7 | 176 | 166 | 157 |
| | | Trial_2 | 208 | 108 | 2 | 193 | 112 | 4 | 187 | 94 | 8 | 177 | 166 | 158 |
| | | Trial_3 | 202 | 104 | 0 | 195 | 105 | 1 | 189 | 96 | 8 | 180 | 166 | 155 |
| | | Trial_4 | 201 | 104 | 1 | 196 | 109 | 0 | 192 | 99 | 7 | 180 | 167 | 161 |
| | | Trial_5 | 200 | 103 | 2 | 198 | 108 | 0 | 193 | 98 | 7 | 181 | 170 | 159 |
| | 1.00E-02 | Trial_1 | 217 | 114 | 1 | 200 | 108 | 1 | 200 | 105 | 6 | 185 | 167 | 158 |
| | | Trial_2 | 211 | 105 | 0 | 200 | 113 | 1 | 199 | 102 | 5 | 187 | 173 | 159 |
| | | Trial_3 | 214 | 109 | 0 | 201 | 104 | 0 | 200 | 106 | 7 | 189 | 171 | 158 |
| | | Trial_4 | 211 | 106 | 0 | 203 | 108 | 1 | 201 | 100 | 5 | 190 | 170 | 158 |
| | | Trial_5 | 218 | 110 | 0 | 203 | 114 | 2 | 202 | 100 | 6 | 192 | 173 | 160 |

| | | | D-11-Ag | | | | | | D-11-Hg | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0.0001 M | | | 0.00001 M | | | 0.0001 M | | | 0.00001 M | | |
| | | | R | G | B | R | G | B | R | G | B | R | G | B |
| I- | 0 | Trial_1 | 193 | 56 | 8 | 203 | 96 | 1 | 154 | 49 | 24 | 178 | 142 | 185 |
| | | Trial_2 | 196 | 57 | 7 | 205 | 96 | 1 | 150 | 42 | 22 | 179 | 145 | 190 |
| | | Trial_3 | 201 | 59 | 5 | 205 | 96 | 1 | 156 | 43 | 21 | 182 | 145 | 189 |
| | | Trial_4 | 203 | 59 | 7 | 204 | 96 | 1 | 160 | 41 | 23 | 185 | 143 | 190 |
| | | Trial_5 | 200 | 56 | 7 | 205 | 98 | 1 | 161 | 39 | 19 | 195 | 145 | 195 |
| | 1.00E-05 | Trial_1 | 184 | 62 | 9 | 198 | 99 | 1 | 155 | 52 | 28 | 186 | 145 | 190 |
| | | Trial_2 | 187 | 60 | 8 | 199 | 99 | 1 | 155 | 49 | 26 | 188 | 143 | 192 |
| | | Trial_3 | 188 | 62 | 8 | 199 | 103 | 1 | 155 | 46 | 23 | 189 | 148 | 194 |
| | | Trial_4 | 185 | 62 | 8 | 203 | 98 | 1 | 159 | 47 | 27 | 188 | 146 | 192 |
| | | Trial_5 | 193 | 65 | 7 | 205 | 103 | 1 | 167 | 45 | 23 | 192 | 146 | 194 |
| | 5.00E-05 | Trial_1 | 182 | 69 | 11 | 204 | 103 | 0 | 171 | 58 | 19 | 189 | 184 | 162 |
| | | Trial_2 | 179 | 68 | 9 | 205 | 103 | 0 | 169 | 57 | 18 | 192 | 180 | 151 |
| | | Trial_3 | 185 | 72 | 9 | 203 | 103 | 1 | 174 | 56 | 19 | 193 | 184 | 158 |
| | | Trial_4 | 182 | 66 | 9 | 203 | 105 | 0 | 174 | 62 | 21 | 195 | 185 | 158 |
| | | Trial_5 | 181 | 68 | 9 | 203 | 108 | 0 | 179 | 64 | 21 | 200 | 186 | 155 |
| | 1.00E-04 | Trial_1 | 194 | 72 | 3 | 217 | 106 | 0 | 208 | 131 | 23 | 193 | 184 | 146 |
| | | Trial_2 | 190 | 67 | 2 | 211 | 104 | 1 | 203 | 129 | 23 | 195 | 185 | 152 |
| | | Trial_3 | 192 | 68 | 3 | 211 | 97 | 1 | 211 | 136 | 28 | 197 | 186 | 150 |
| | | Trial_4 | 188 | 72 | 2 | 209 | 101 | 0 | 207 | 135 | 30 | 199 | 186 | 152 |
| | | Trial_5 | 191 | 69 | 1 | 211 | 105 | 0 | 209 | 136 | 27 | 203 | 189 | 150 |
| | 5.00E-04 | Trial_1 | 198 | 108 | 3 | 201 | 111 | 2 | 204 | 99 | 3 | 205 | 193 | 151 |
| | | Trial_2 | 201 | 107 | 2 | 204 | 107 | 0 | 205 | 99 | 2 | 203 | 192 | 150 |
| | | Trial_3 | 205 | 108 | 1 | 206 | 110 | 0 | 207 | 95 | 1 | 203 | 192 | 147 |
| | | Trial_4 | 205 | 107 | 1 | 208 | 111 | 1 | 211 | 99 | 0 | 206 | 195 | 156 |
| | | Trial_5 | 206 | 108 | 1 | 207 | 110 | 1 | 215 | 97 | 0 | 206 | 196 | 157 |
| | 1.00E-03 | Trial_1 | 197 | 105 | 3 | 205 | 108 | 1 | 202 | 101 | 1 | 187 | 177 | 147 |
| | | Trial_2 | 198 | 101 | 2 | 200 | 102 | 1 | 202 | 102 | 1 | 187 | 177 | 145 |
| | | Trial_3 | 201 | 97 | 1 | 202 | 108 | 1 | 205 | 105 | 1 | 190 | 178 | 147 |
| | | Trial_4 | 200 | 100 | 1 | 206 | 108 | 1 | 207 | 103 | 1 | 195 | 179 | 146 |
| | | Trial_5 | 202 | 98 | 2 | 209 | 106 | 0 | 210 | 107 | 0 | 192 | 183 | 146 |
| | 5.00E-03 | Trial_1 | 208 | 100 | 1 | 207 | 107 | 1 | 203 | 106 | 1 | 188 | 179 | 150 |
| | | Trial_2 | 209 | 100 | 1 | 203 | 110 | 1 | 205 | 107 | 0 | 187 | 179 | 149 |
| | | Trial_3 | 209 | 102 | 0 | 206 | 106 | 1 | 204 | 106 | 1 | 189 | 182 | 149 |
| | | Trial_4 | 209 | 103 | 1 | 208 | 107 | 1 | 204 | 108 | 0 | 192 | 183 | 148 |
| | | Trial_5 | 212 | 104 | 1 | 207 | 105 | 1 | 205 | 107 | 1 | 198 | 186 | 150 |
| | 1.00E-02 | Trial_1 | 212 | 104 | 0 | 211 | 112 | 1 | 213 | 113 | 1 | 191 | 182 | 154 |
| | | Trial_2 | 207 | 107 | 1 | 214 | 111 | 1 | 208 | 111 | 0 | 193 | 180 | 153 |
| | | Trial_3 | 214 | 110 | 1 | 210 | 107 | 0 | 211 | 109 | 1 | 189 | 184 | 153 |
| | | Trial_4 | 210 | 109 | 1 | 210 | 105 | 1 | 213 | 110 | 0 | 190 | 179 | 155 |
| | | Trial_5 | 209 | 106 | 0 | 213 | 106 | 1 | 213 | 111 | 1 | 189 | 181 | 149 |