# Supporting information

**Table S1:** Sample preparation parameters for all images shown in the figures of the main text. Abbreviations: sodium hexametaphosphate (SHMP), ultrasonic probe (USP), acoustic power (Pac)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Figure** | **Material** | **Suspension preparation** | **Spray voltage / V** | **Liquid flow rate / ml/h** | **CO2 flow rate / L/min** | **Current / nA** | **Distance capillary – substrate / mm** | **Deposition time / s** | **Substrate** |
| **Figure 2a** | Au NPs | As provided | 8050 | 0.009 | 0.34 |  | 13.2 | 600 | Formvar TEM grid |
| **Figure 2b,c** | Au NPs | As provided | 8050 | 0.009 | 0.34 |  | 13.2 | 300 | Carbon TEM grid |
| **Figure 3a,b** | SiO2 (ERM FD304) | Diluted 1+100 | 7270 | 0.015 | 0.32 |  | 16 | 300 | Carbon TEM grid |
| **Figure 3c-f** | SiO2 (ERM FD102) | As provided | 7020 | 0.03 | 0.34 |  | 16 | 5 | Carbon TEM grid |
| **Figure 4** | PSL tri-modal | Diluted 1+100 | 8000 | 0.042 | 0.42 | 113 | 16 | 60 | Si wafer |
| **Figure 5a-e** | BaSO4 (f) | 2.5 mg/ml BaSO4 in 2mg/ml aqueous SHMP solution, 20 min USP with Pac=9.55W | 6570 | 0.012 | 0.32 | 380 | 16 | 300 | Carbon TEM grid |
| **Figure 5f-h** | BaSO4 (uf) | 2.5 mg/ml BaSO4 in 2mg/ml aqueous SHMP solution, 5 min USP with Pac=9.55W | 6190 | 0.02 | 0.27 | 350 | 16 | 30 | Carbon TEM grid |
| **Figure 6a** | BaSO4 (f) | 2.5 mg/ml BaSO4 in 2mg/ml aqueous SHMP solution, 20 min USP with Pac=9.55W | 6570 | 0.012 | 0.32 | 380 | 16 | 300 | Carbon TEM grid |
| **Figure 6b** | BaSO4 (f) | 2.5 mg/ml BaSO4 in 0.2mg/ml aqueous SHMP solution, 20 min USP with Pac=9.55W | 6955 | 0.02 | 0.28 | 215 | 16 | 120 | Carbon TEM grid |
| **Figure 6c** | BaSO4 (f) | 2.5 mg/ml BaSO4 in 0.02mg/ml aqueous SHMP solution, 20 min USP with Pac=9.55W | 7560 | 0.06 | 0.29 | 215 | 16 | 120 | Carbon TEM grid |
| **Figure 6d** | BaSO4 (uf) | 2.5 mg/ml BaSO4 in 2mg/ml aqueous SHMP solution, 5 min USP with Pac=9.55W | 6190 | 0.02 | 0.27 | 350 | 16 | 30 | Carbon TEM grid |
| **Figure 6e** | BaSO4 (uf) | 2.5 mg/ml BaSO4 in 0.2mg/ml aqueous SHMP solution, 5 min USP with Pac=9.55W | 7526 | 0.03 | 0.25 | 240 | 16 | 30 | Carbon TEM grid |
| **Figure 6f** | BaSO4 (uf) | 2.5 mg/ml BaSO4 in 0.02mg/ml aqueous SHMP solution, 5 min USP with Pac=9.55W | 7753 | 0.05 | 0.28 | 140 | 16 | 30 | Carbon TEM grid |
| **Figure 7a,b** | Kaolin | 2.5 mg/ml aqueous kaolin suspension, 10 min USP with Pac=40W | 7238 | 0.08 | 0.22 | 220 | 16 | 5 | Carbon TEM grid |
| **Figure 7c,d** | Kaolin | 2.5 mg/ml aqueous kaolin suspension, 10 min USP with Pac=40W | 7238 | 0.08 | 0.22 | 220 | 16 | 30 | Carbon TEM grid |