

Transformation of Silver Nanoparticle Consumer Products during Simulated Usage and Disposal

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Hydrodynamic diameter and polydispersity index were obtained with a Malvern Zetasizer Nano-ZS (Malvern Panalytical Ltd.). pH was measured with an Accumet AP85 pH meter (Fisher Scientific LLC). Anion concentration was measured using a Dionex ICS-5000+ ion chromatograph (Thermo Fisher Scientific Inc.) equipped with an AS18 anion-exchange column. Consumer products were used as-is from manufacturer packaging.

Table S-1. Physicochemical characteristics of 22 AgNP-containing consumer products.

CP #	Hydrodynamic diameter (nm)	Polydispersity Index	pH	Cl- (ppm)
1	166.9 ± 31.47	0.43	6.6	bdl
2	284.7 ± 29.53	0.51	2.9	3.58
3	264.1 ± 17.26	0.45	4.33	72.08
4	57.46 ± 0.90	0.46	7.9	39.81
5	82.99 ± 5.59	0.69	6.1	0.39
6	55.91 ± 15.69	0.42	8.9	bdl
7	245.5 ± 11.62	0.29	10.6	25.12
8	220.2 ± 5.86	0.34	10.0	25.29
9	68.4 ± 100.2	0.47	6.3	0.41
10	484.4 ± 224.8	0.72	2.6	3.44
11	149.5 ± 84.55	0.58	4.1	0.39
12	181.5 ± 57.56	0.57	5.1	0.38
13	144.6 ± 58.51	0.52	8.4	4.58
14	119.3 ± 36.53	0.45	7.6	0.4
15	221.2 ± 9.53	0.43	5.4	0.31
16	58.8 ± 1.88	0.60	5.0	0.31
17	159.6 ± 28.04	0.40	5.2	0.32
18	479.6 ± 374.8	0.73	4.5	0.33
19	299.7 ± 175.9	0.67	4.1	0.35
20	421 ± 40.41	0.43	2.5	10.58
21	126.8 ± 245	-	6.83	0.31
22	234 ± 29.08	0.50	7.03	0.35

bdl = below detection limit

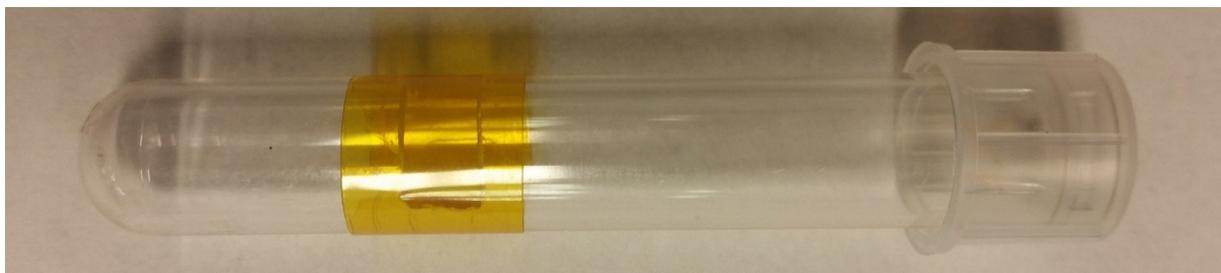
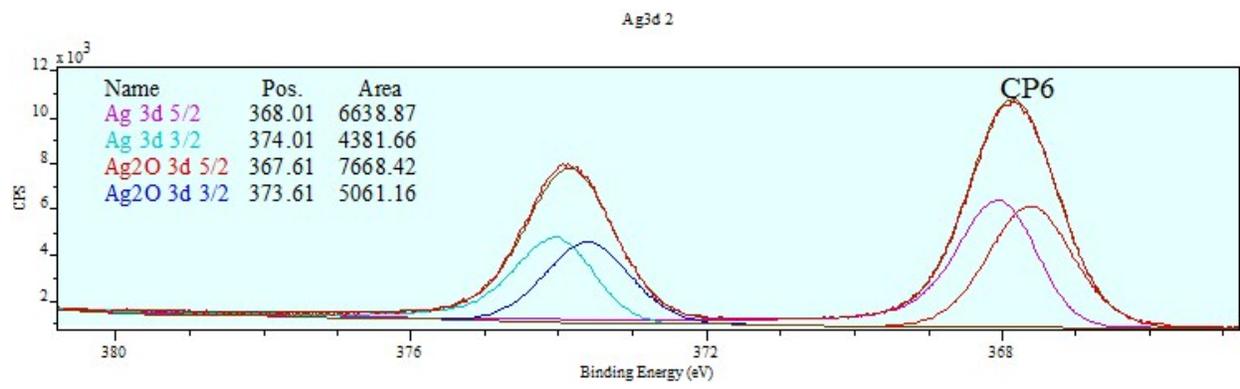
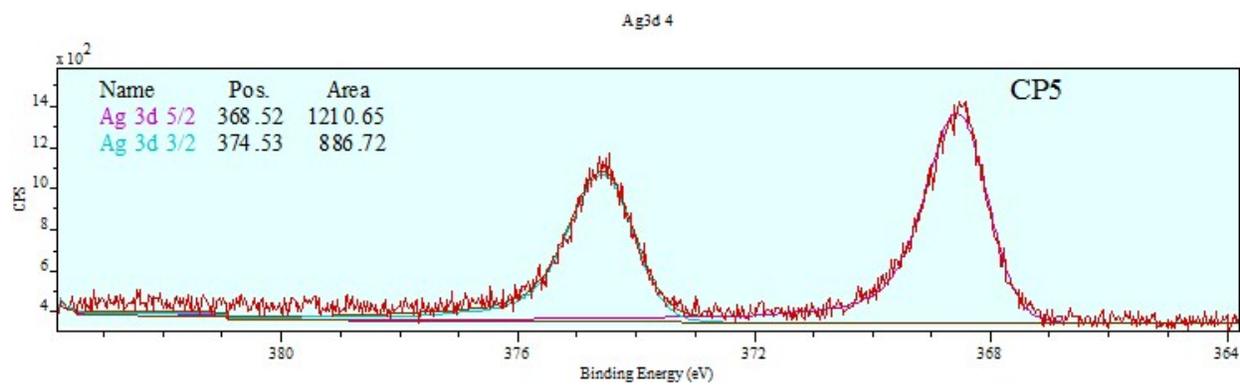
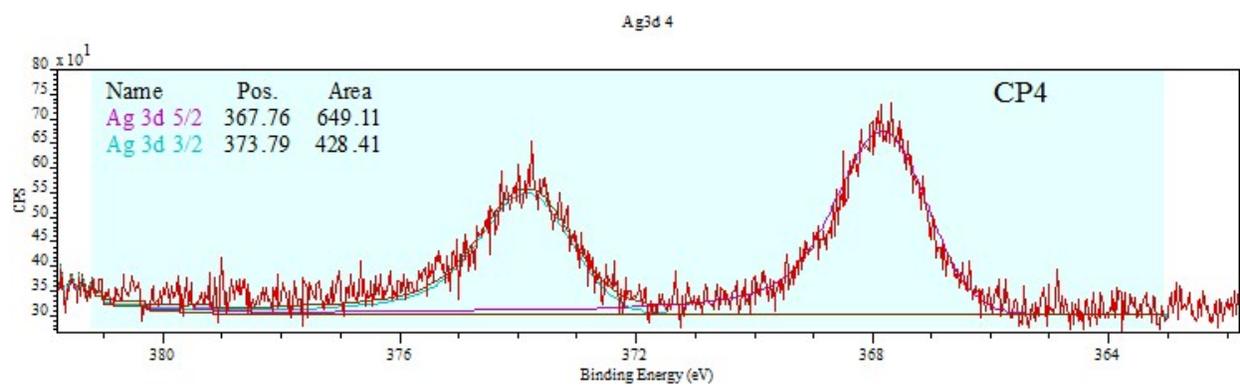
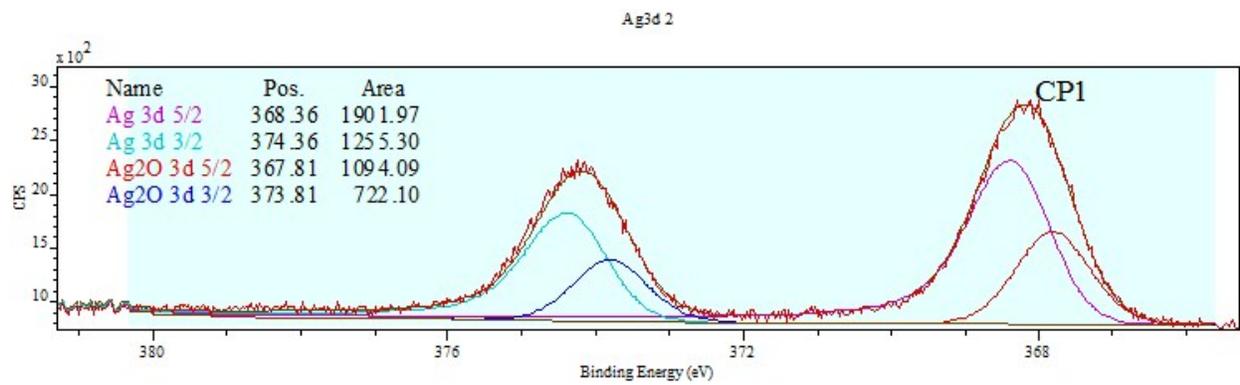
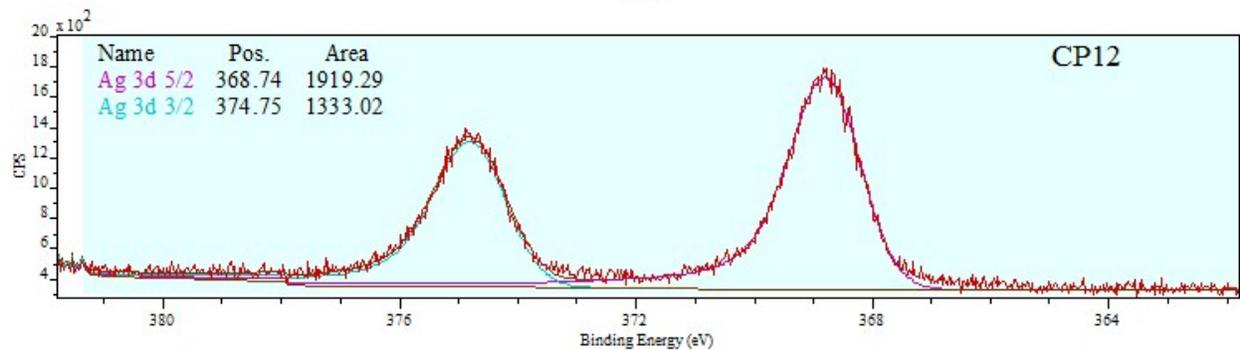
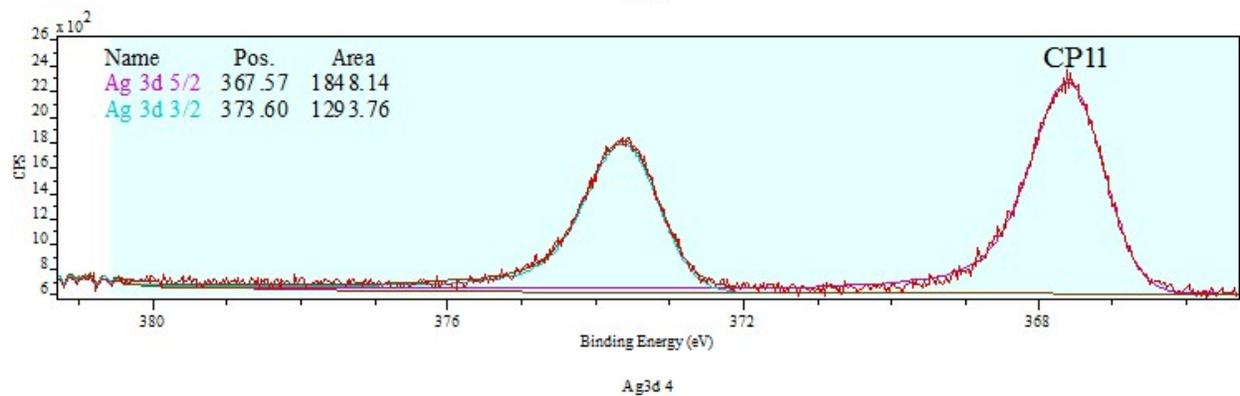
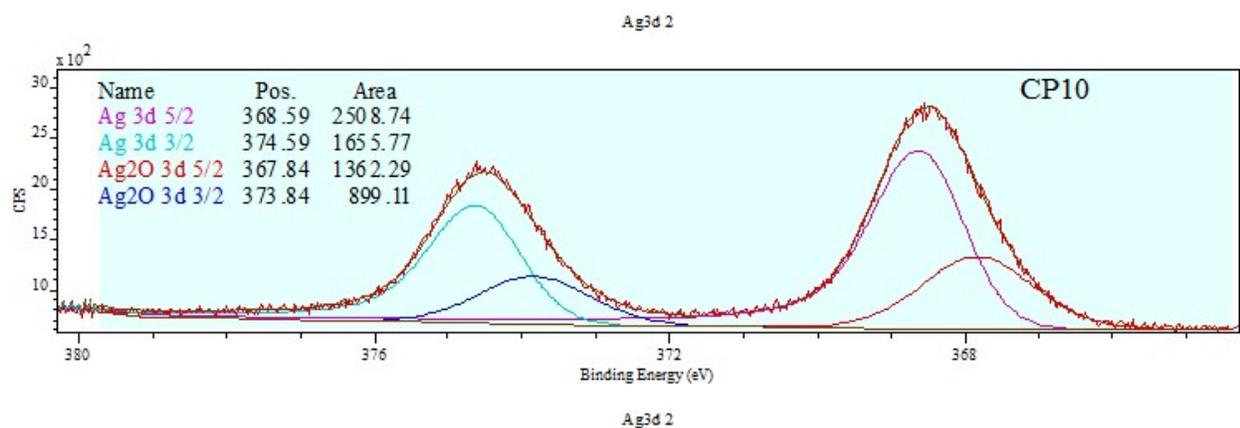
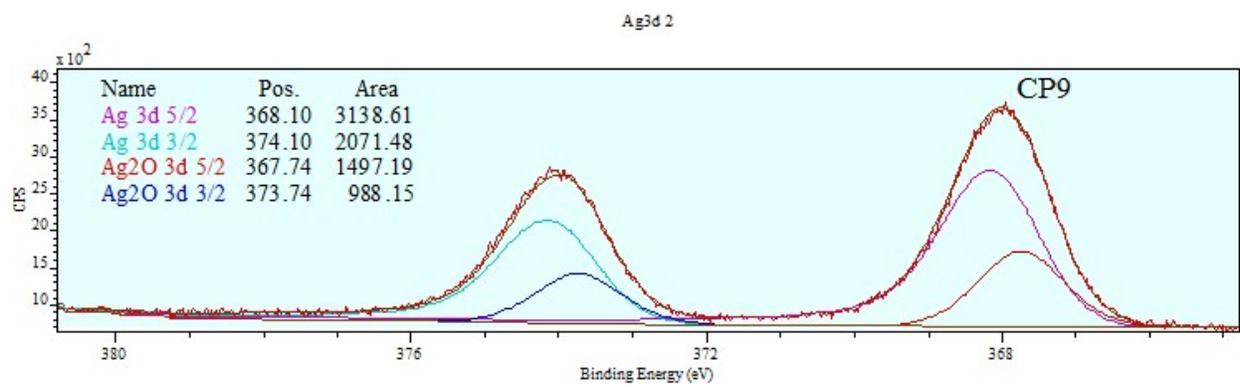
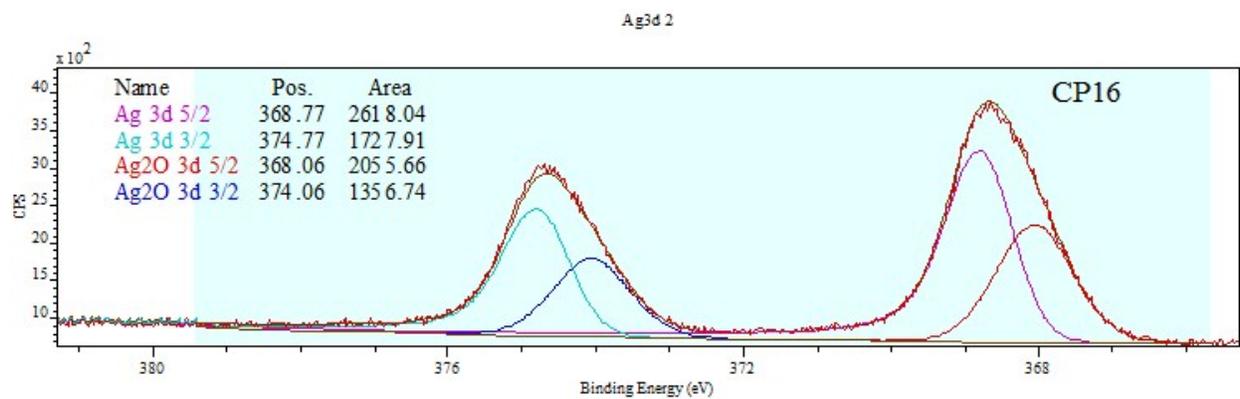
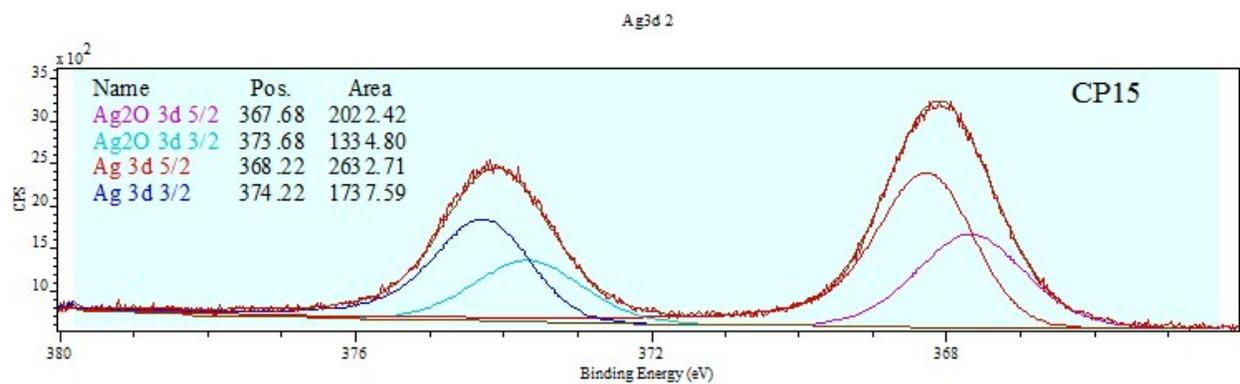
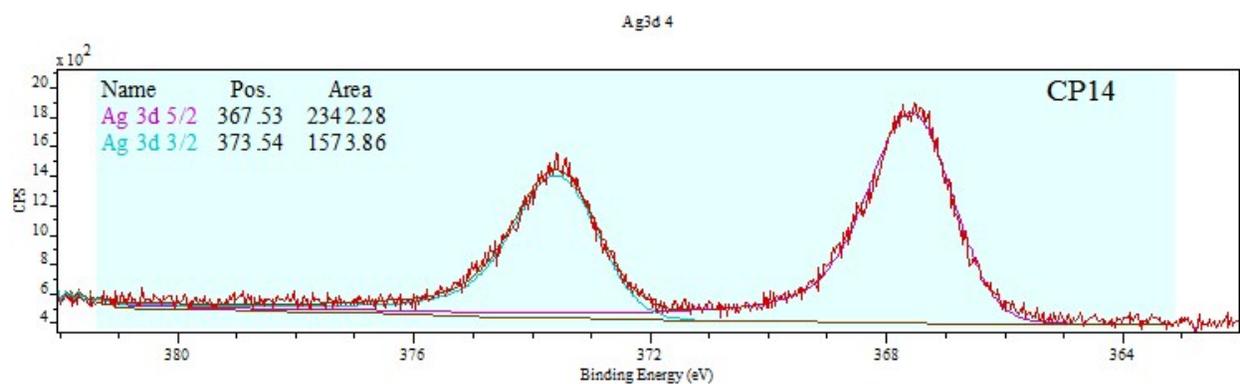
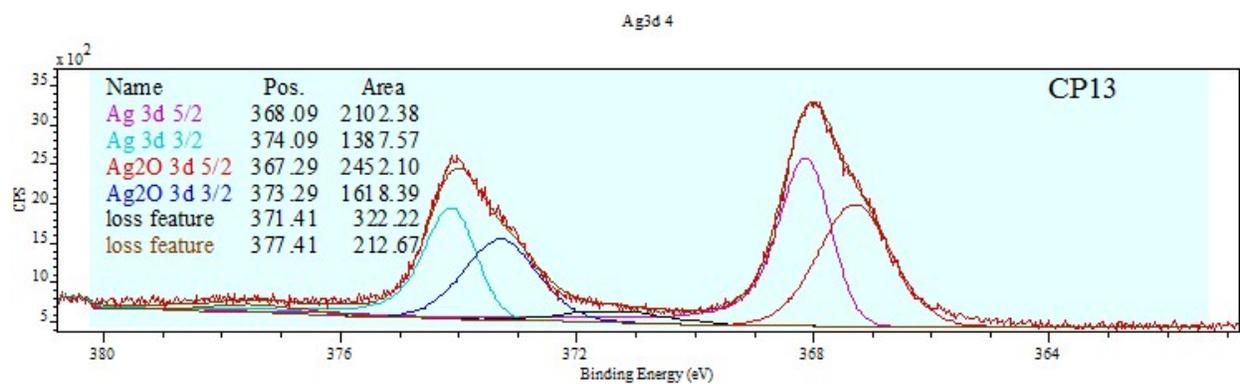


Figure S-1. Reactor design allows x-ray transmission through Kapton window during reaction.







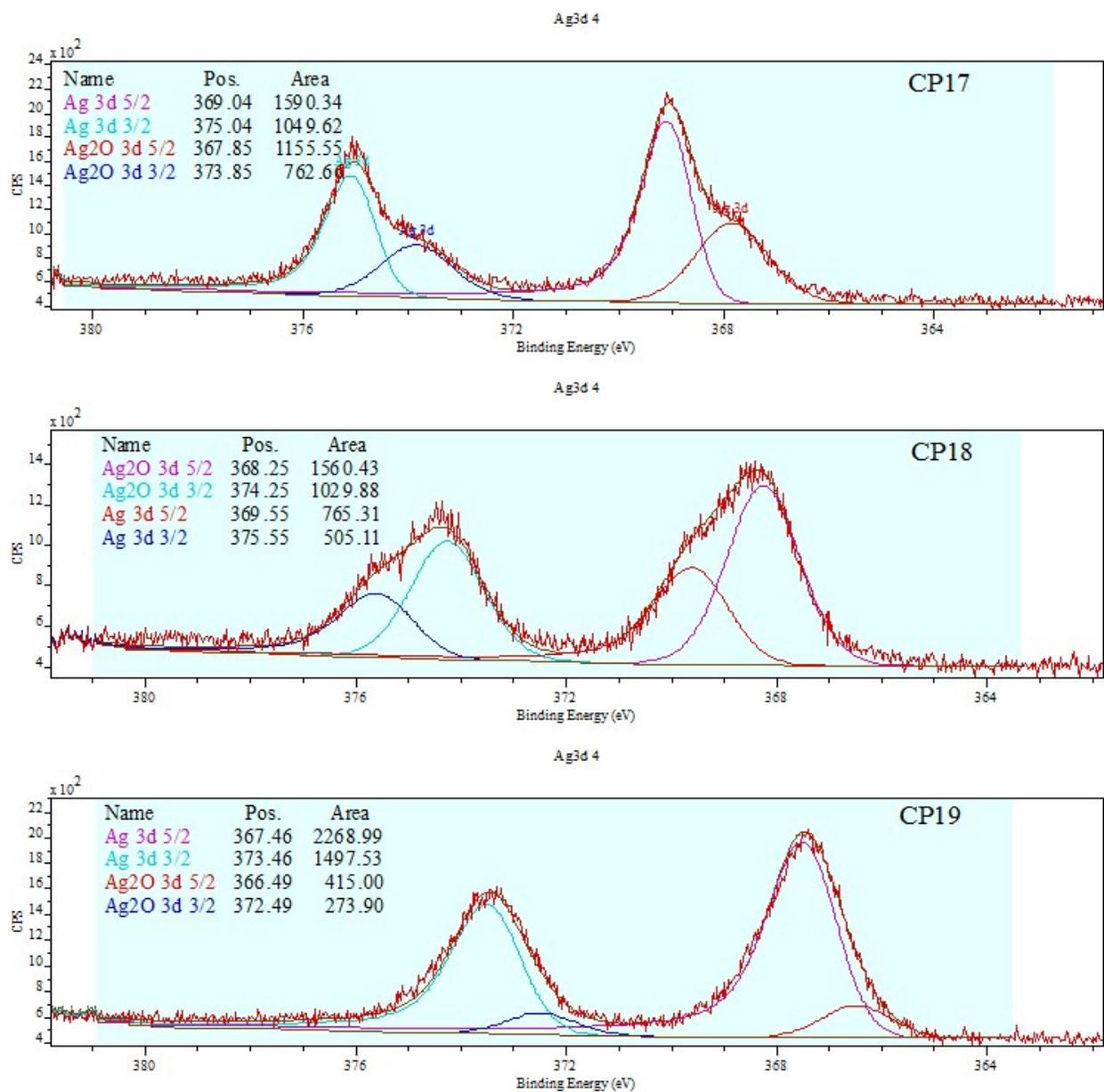


Figure S-2. X-ray photoelectron spectra of Ag 3d region showing Ag speciation in air-dried consumer products. CP2, 3, 7, 8, 20, 21, and 22 excluded due to no detectable Ag.

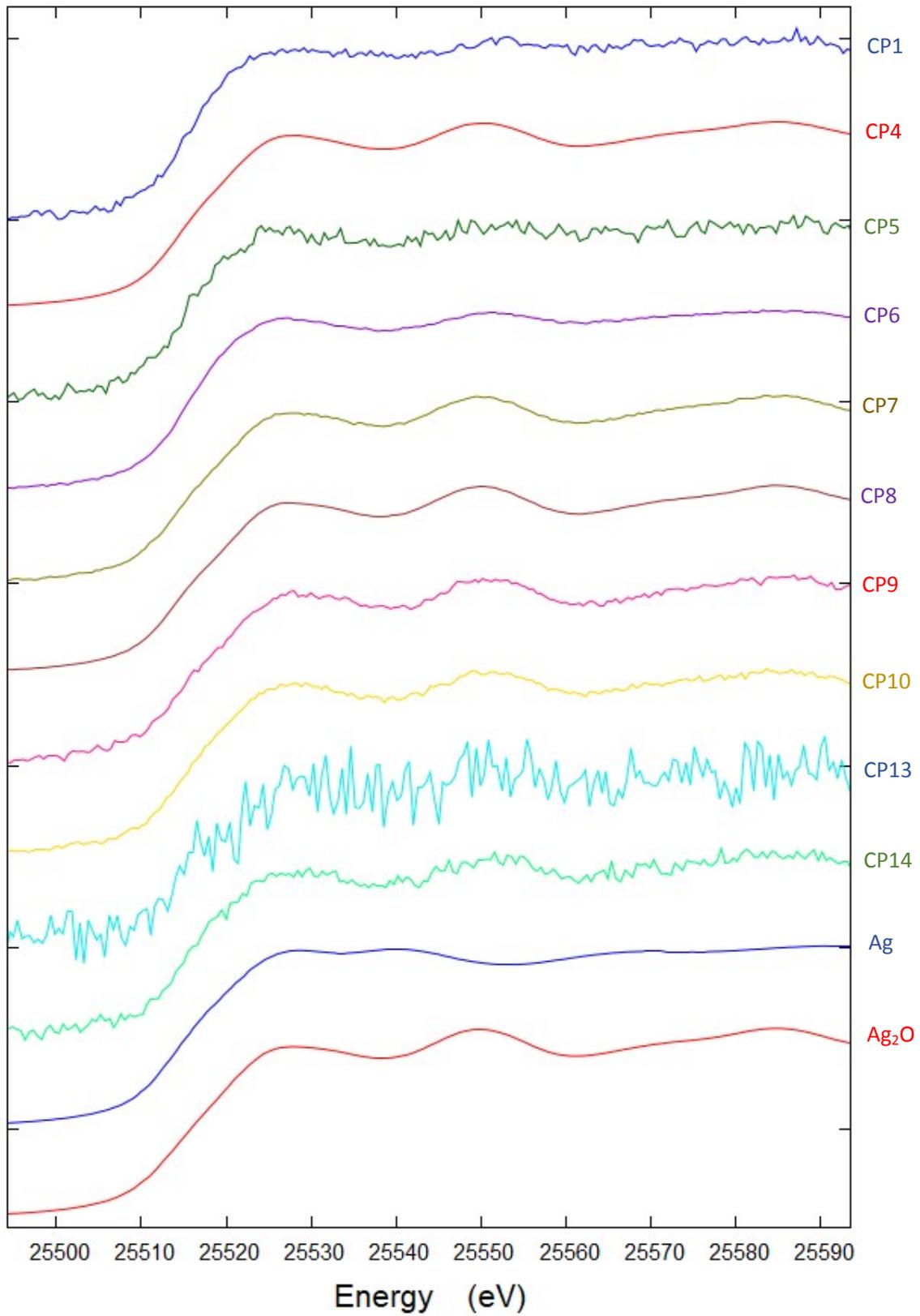


Figure S-3. XANES spectra for CP1, 4, 5, 6, 7, 8, 9, 10, 13, 14, Ag₂O, and Ag.

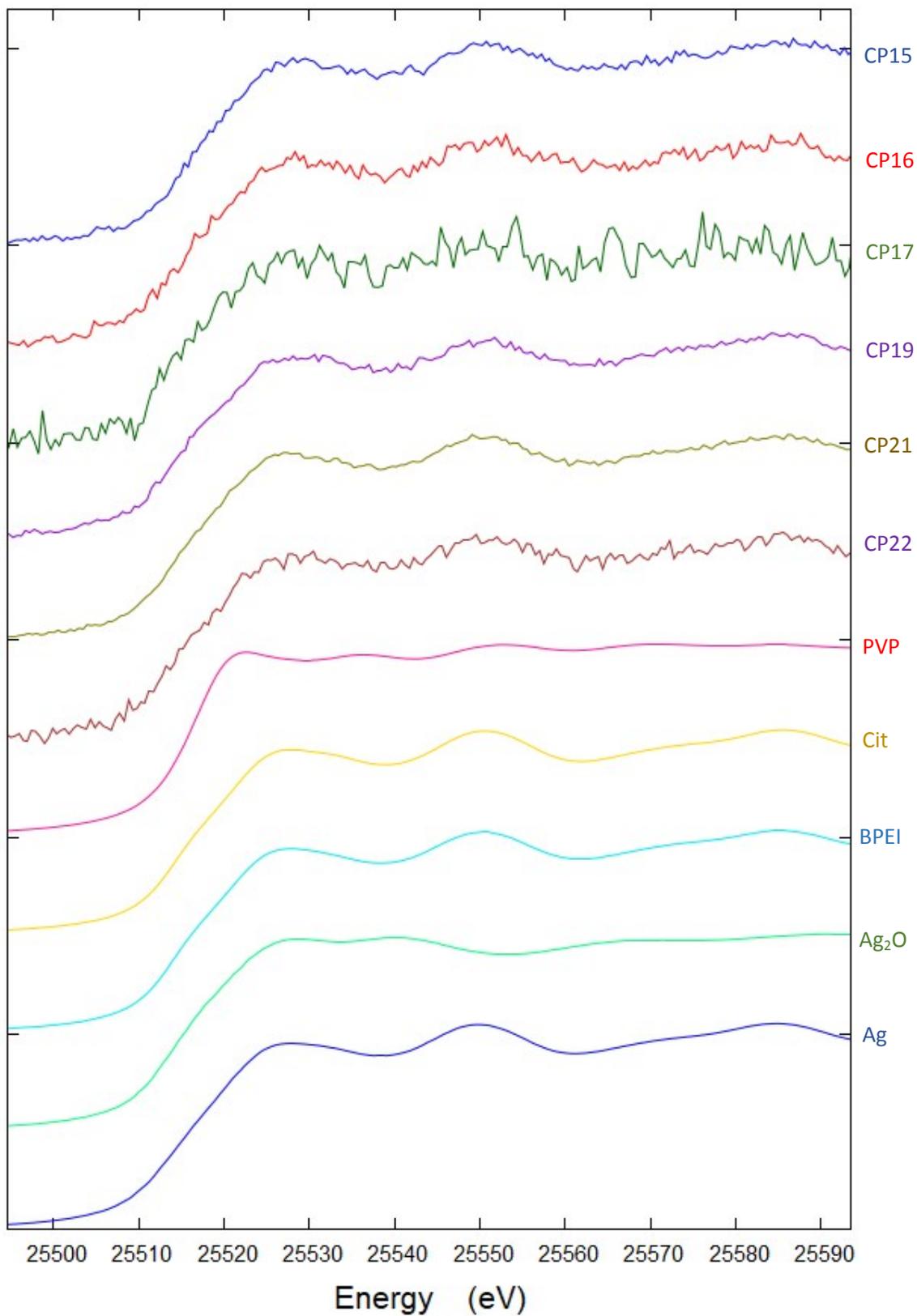


Figure S-4. XANES spectra for CP15, 16, 17, 19, 21, 22, Ag₂O, and Ag.

Transmission Electron Microscopy (TEM)

Samples were prepared for TEM analysis by dropcasting approximately 20 μL of CP onto a Ni grid and allowing it to air-dry in a desiccator. Micrographs were collected at 300 kV with a JEOL-1200 EX (JEOL Inc.) to determine nanoparticle size and shape. Nanoparticle diameter was measured and size distributions were calculated using ImageJ software (ImageJ, U.S. NIH, <http://rsb.info.nih.gov/ij/>).

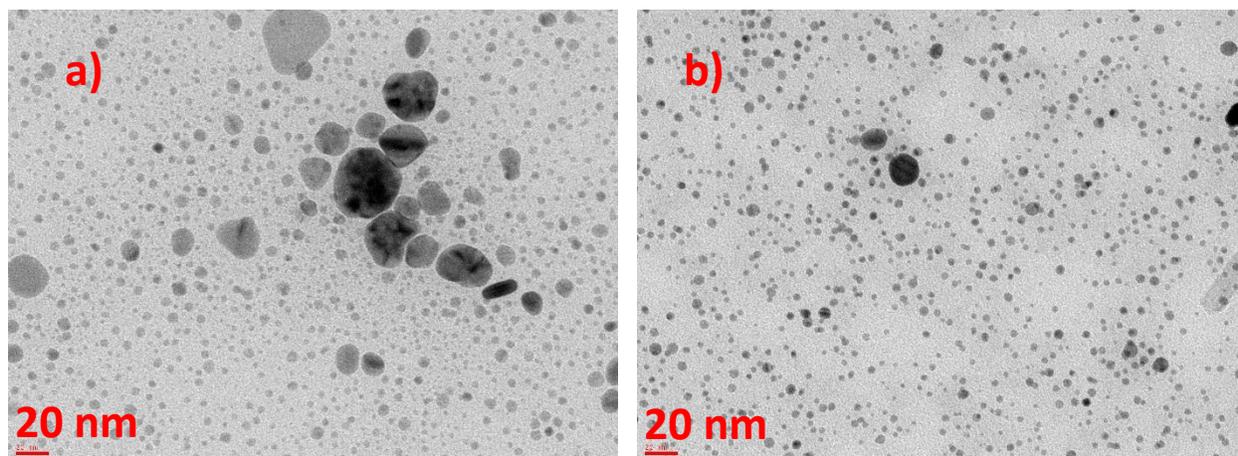


Figure S-5. TEM micrographs of a) CP4 and b) CP6 showing a high degree of polydispersity.

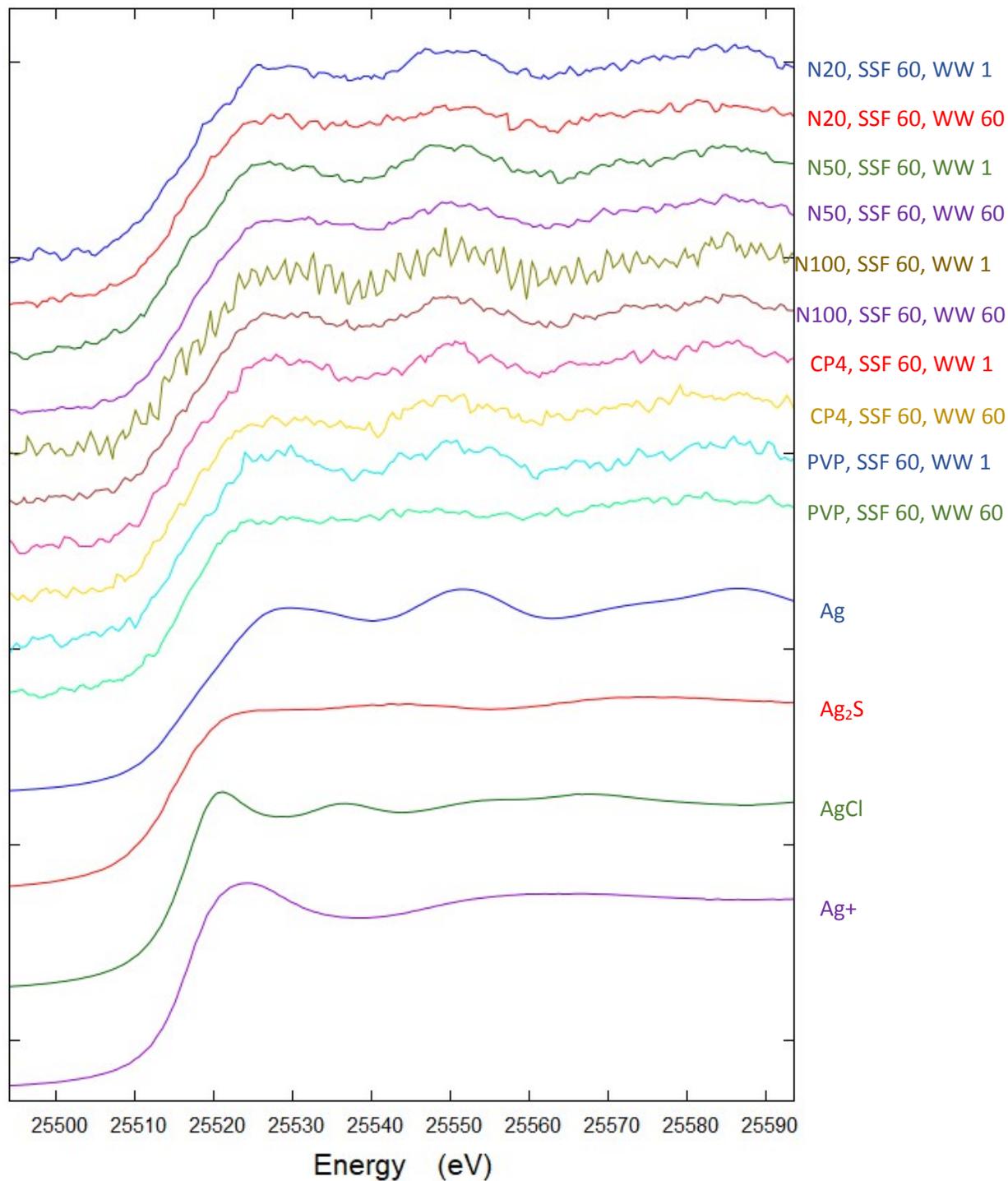


Figure S-6. XANES spectra of AgNPs during sequential exposure to SSF and wastewater sludge. “SSF 60, WW 1” indicates AgNPs after one hour of SSF exposure followed by wastewater (WW) addition and “SSF 60, WW 60” indicates one hour of SSF followed by one hour of WW exposure.

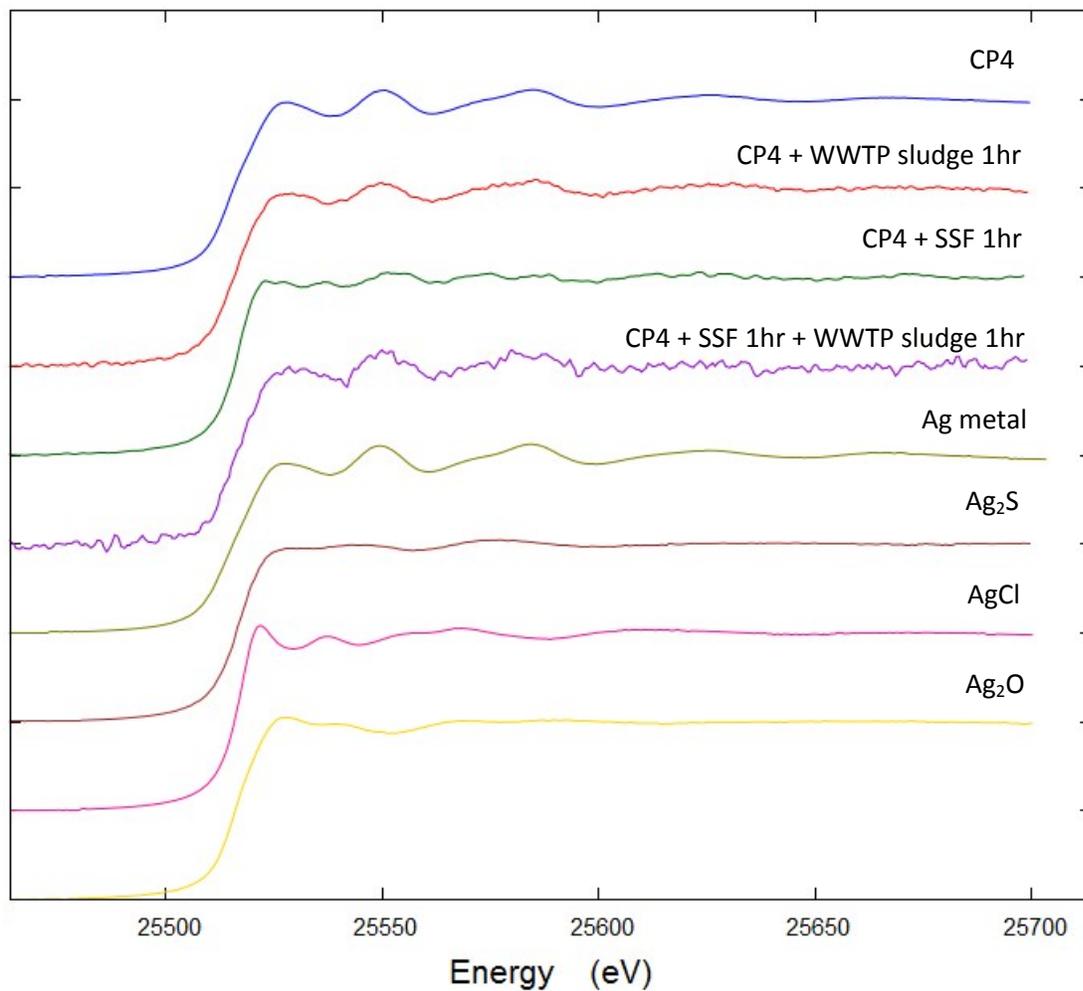


Figure S-7. XANES spectra of CP4 mixed with various media along with silver reference materials.