Supporting information for

# Synergism of mechanical activation and sulfurization to recover copper from waste printed circuit boards

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**Table S1.** Elemental compositions (wt%) in Area-Ⅳ~Ⅵ, Figure 1-B, from the energy dispersive X-ray analysis.

| Type | C | O | Cu | Al | Au[a] |
|---|---|---|---|---|---|
| Area-IV | 1.26 | - | 79.24 | - | 19.50 |
| Area-V | 12.35 | 2.01 | 58.43 | - | 27.21 |
| Area-VI | 38.02 | 21.08 | 3.15 | 0.41 | 37.33 |

[a] Au is sprayed on the surface of the samples to improve the conductivity during the SEM analysis.

**Table 2.** Specific species in Cu2-xS and corresponding weight percentages (wt%) in different ball-milling time, from the two XRD analyses.

| | 5 min | | 10 min | | 15 min | | 20 min | | 25 min | | 30 min | | 40 min | | 60 min | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $Cu_2S$ | 15.02 | 18.13 | 22.65 | 22.17 | 20.08 | 26.69 | 18.09 | 18.13 | 26.90 | 31.27 | 40.12 | 38.89 | 53.89 | 57.77 | 54.09 | 60.49 |
| $Cu_{1.96}S$ | 4.21 | 5.93 | 2.37 | 1.92 | 1.99 | 3.09 | 1.80 | - | 1.12 | 1.62 | - | - | - | - | - | - |
| $Cu_{1.95}S$ | 2.95 | - | - | 3.98 | - | - | - | - | - | - | - | - | - | - | - | - |
| $Cu_{1.92}S$ | - | - | 4.04 | - | - | - | - | - | - | - | - | - | - | - | - | - |

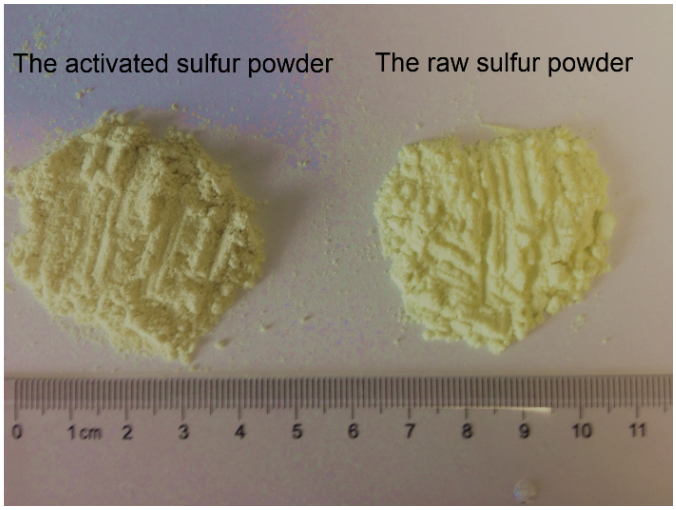


**Figure S1.** The raw sulfur powder and the activated sulfur powder.

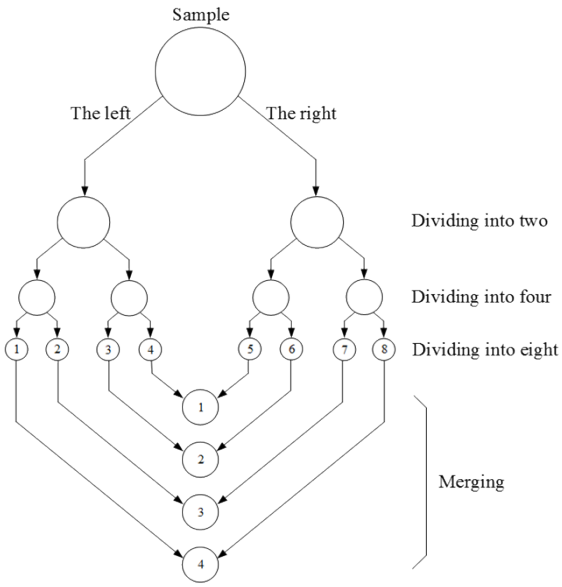


**Figure S2.** The Carpenter left-right balancing method.