# Supporting Information

## Amorphous Cu-In-S nanoparticle-based precursor ink with improved atom economy for CuInSe$_2$ solar cells with 10.85% efficiency

SeJin Ahn,[a,b] Shanza Rehan,[a,b] Dong Gwon Moon,[a,c] Young-Joo Eo,[a,b] SeungKyu Ahn,[a,b] Jae Ho Yun,[a,b] Ara Cho,[*,a,b] and Jihye Gwak,[*,a,b]

[a]Photovoltaic Laboratory, Korea Institute of Energy Research, Daejeon 305-343, Korea.

[b]Department of Renewable Energy Engineering, Korea University of Science and Technology (UST), DaeJeon 305-350, Korea.

[c]Department of Materials Science and Engineering, Yonsei University, Seoul 120-749, Korea.
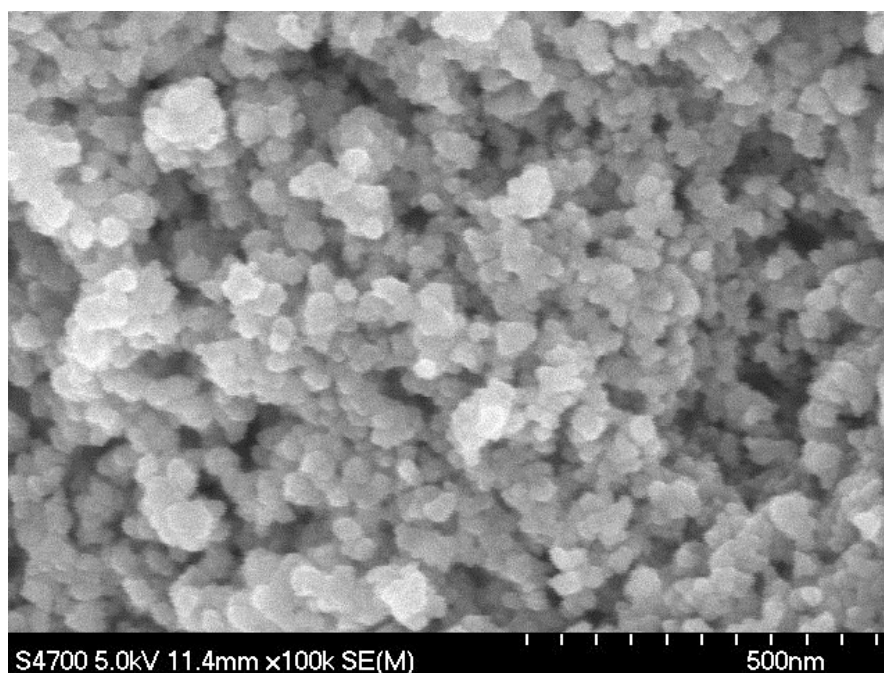
Figure S1. SEM image of the amorphous Cu-In-S nanoparticles.

Table S2. Calculation procedures for quantitative estimation of the atom economy of the two routes using a value of OMR.

- **Organic to Metal Ratio (OMR) =** $\dfrac{amount\ of\ organic\ ligand\ (MEA)\ in\ mol}{amount\ of\ metal\ atoms\ in\ mol}$

|  | Route 1 | Route 2 |
|---|---|---|
| **MEA / mol ------------------------------------------------- (i)** | **0.01965** | **0.0109** |
| Cu-In-S nanoparticles (NP)* / mol | 0.00495 | 0.00495 |
| **Metal atoms (Cu and In) in NPs / mol ----------- (ii)** | **0.0099** | **0.0099** |
| Metal-acetate / mol | 0 | Cu(II)-acetate : 0.00083<br>In(III)-acetate : 0.00083 |
| **Metal atoms in metal-acetate / mol -------------- (iii)** | **0** | **0.00166** |
| **Total metal atoms / mol ----------------- (iv)=(ii)+(iii)** | **0.0099** | **0.01156** |
| **OMR ---------------------------------------------------- (i)/(iv)** | **1.985** | **0.943** |
| **Relative OMR** | **1** | **0.475** |

* MW of CuInS$_2$ (242.5) was used for calculation of mol of Cu-In-S nanoparticles.

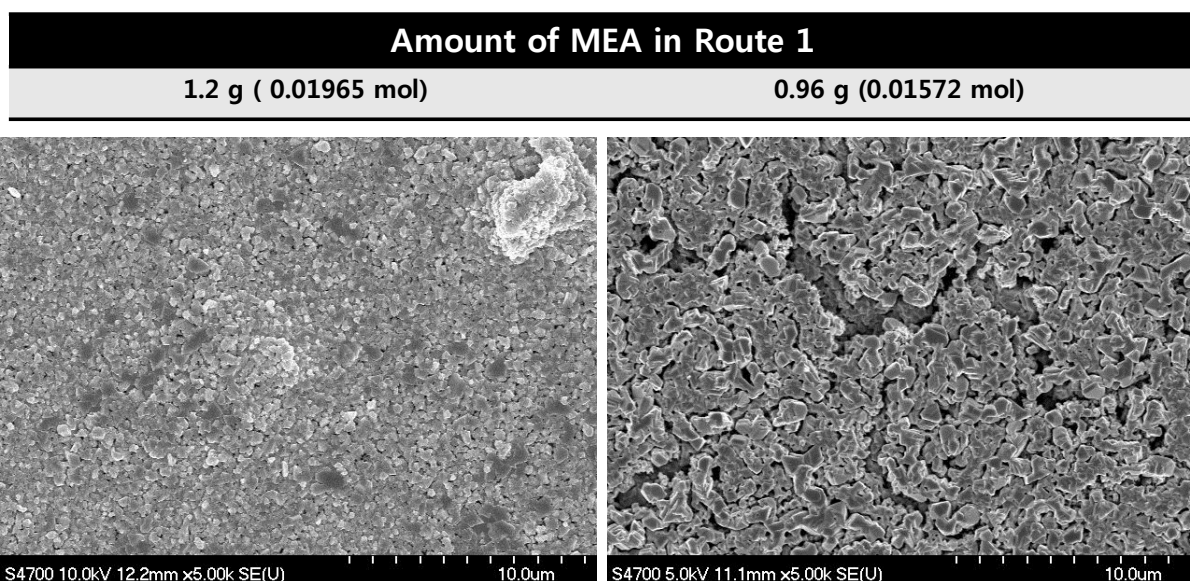| Amount of MEA in Route 1 | |
| --- | --- |
| 1.2 g ( 0.01965 mol) | 0.96 g (0.01572 mol) |



Figure S3. SEM images of the CISe films processed using the Route 1 ink with different amounts of MEA.