Supplementary information

**From macro to micro: multi-scale study of plasmonic nanocoating self-assembled on multijunction bulk solar cells**

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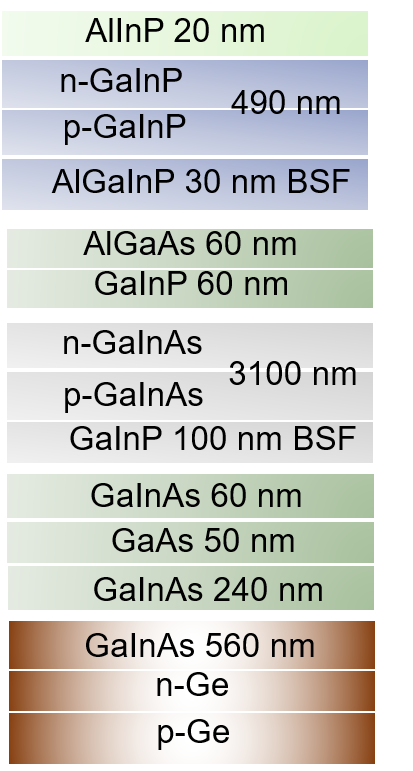
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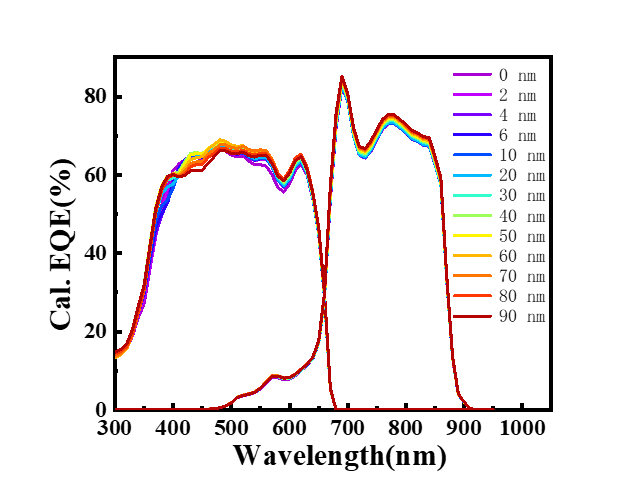
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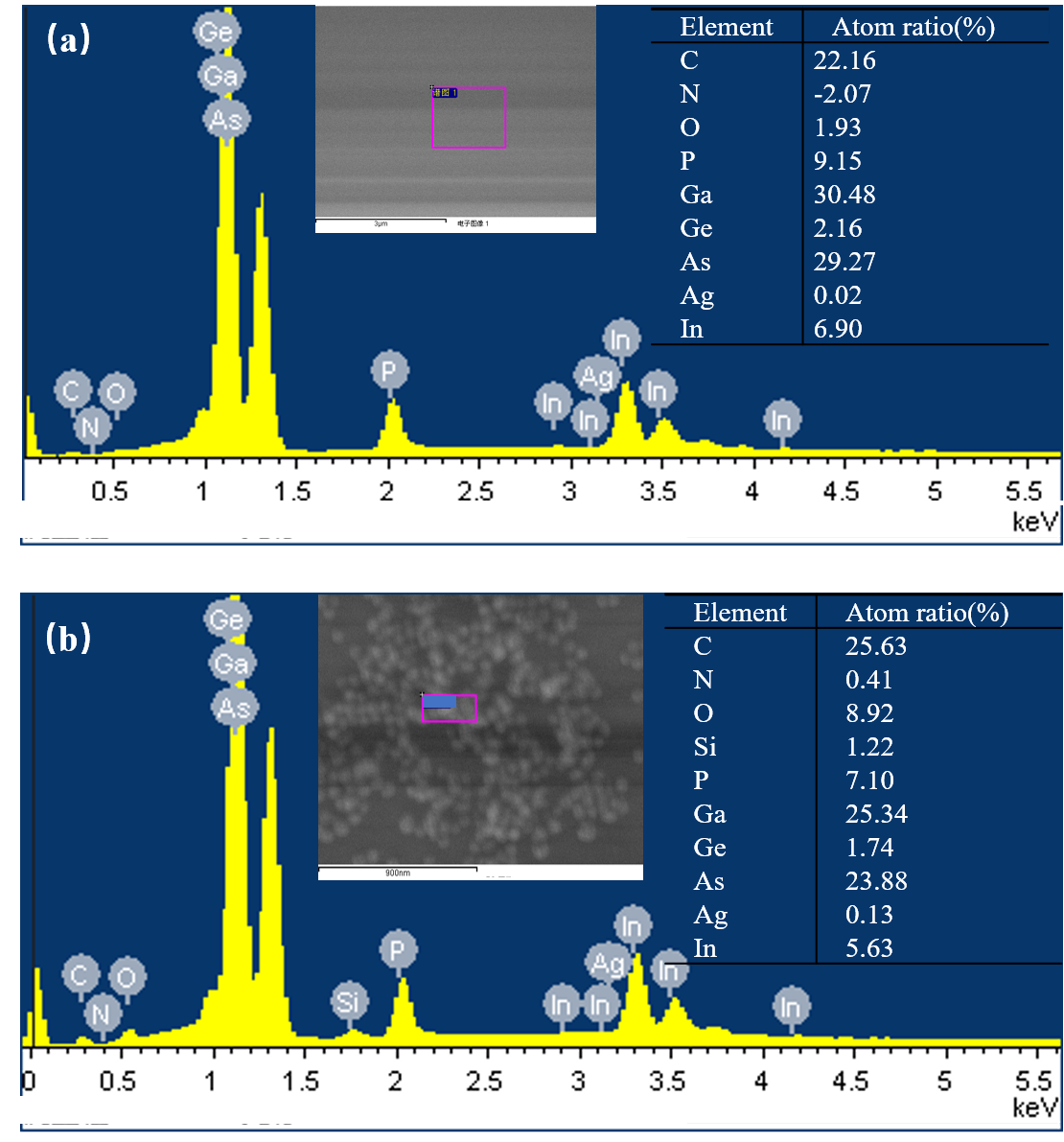
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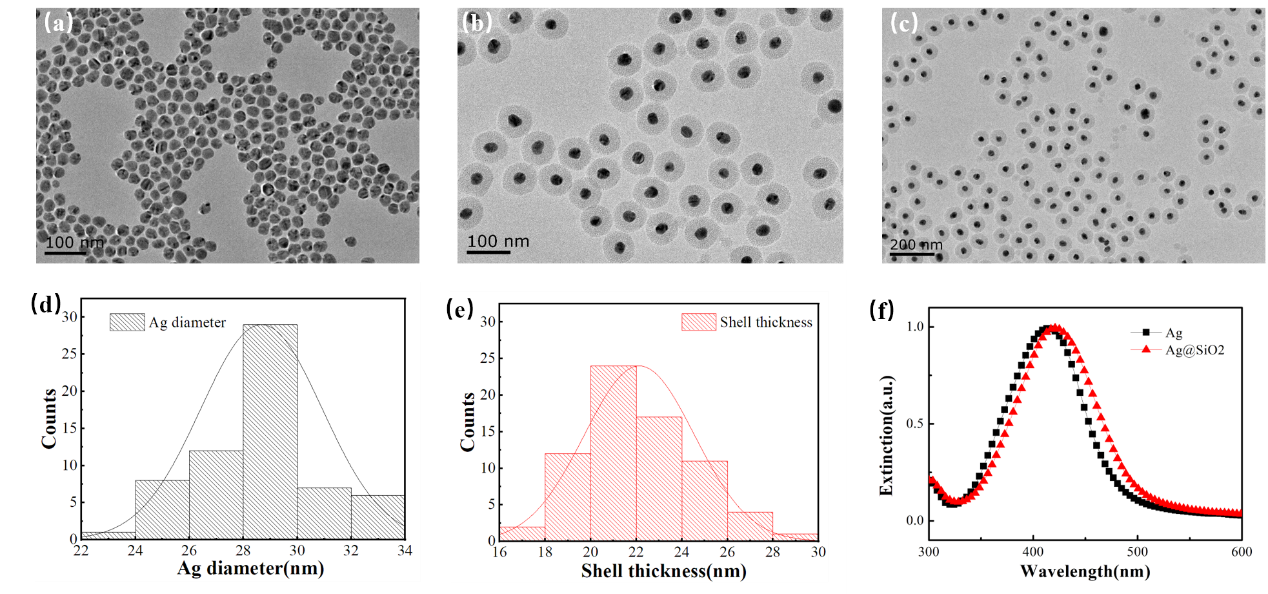
**Supplementary Fig. 1| Simulation structural parameters of MJSC.**



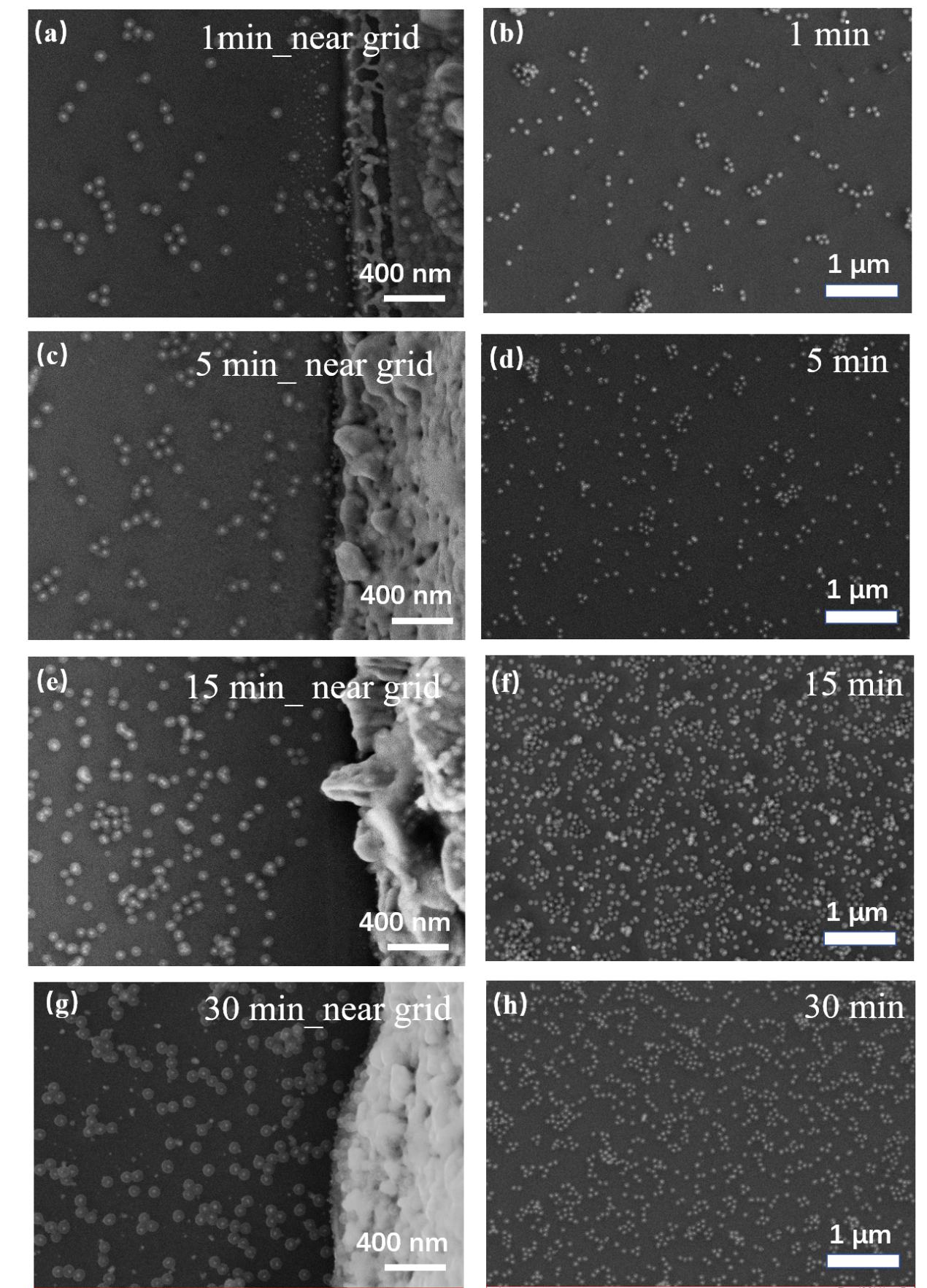
**Supplementary Fig. 2| Calculated EQE of the single dispersed particle on MJSC.**



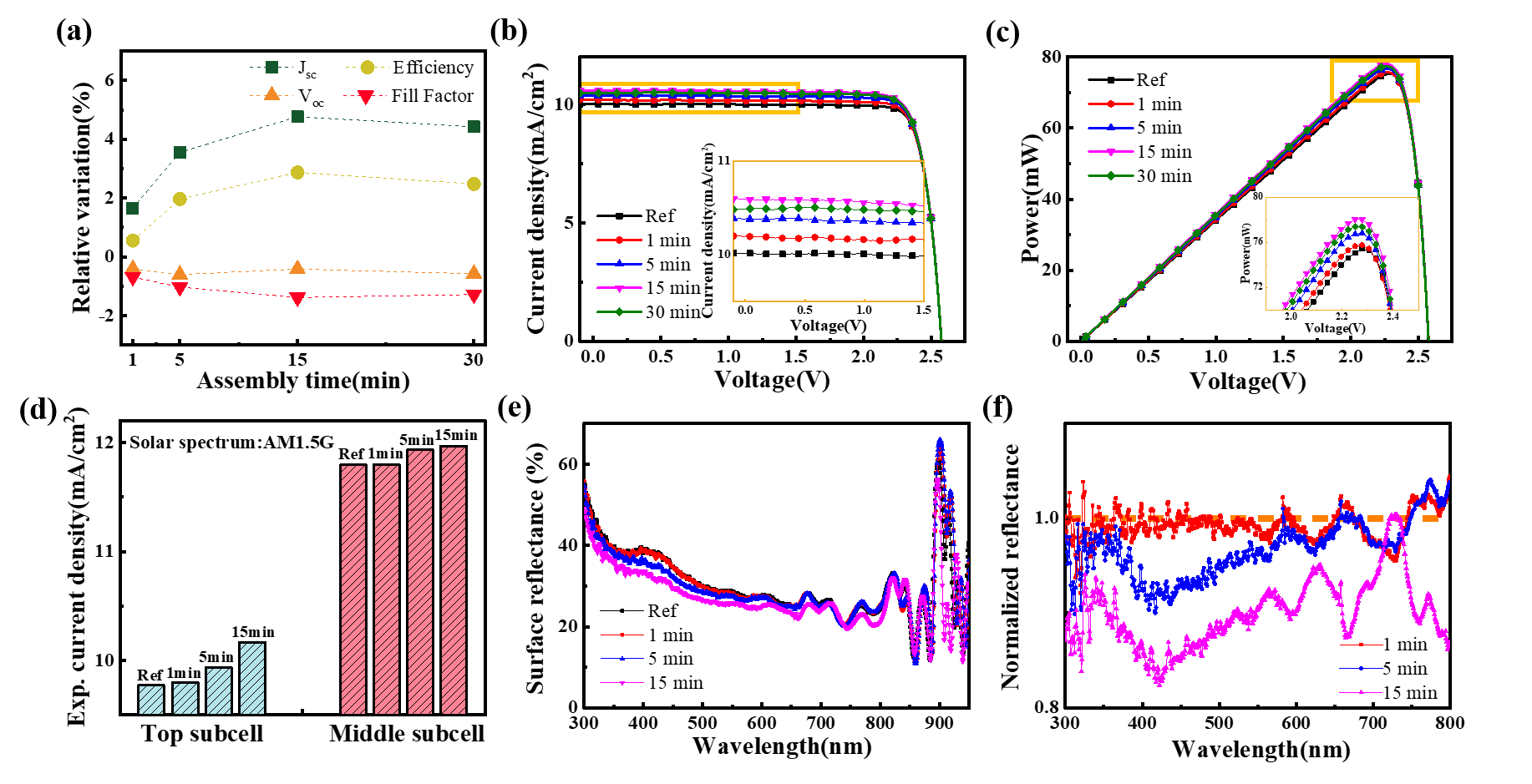
**Supplementary Fig. 3| EDS Characterization of Ag@SiO2 core-shell nanostructure on InGaP-GaAs-Ge MJSC.**

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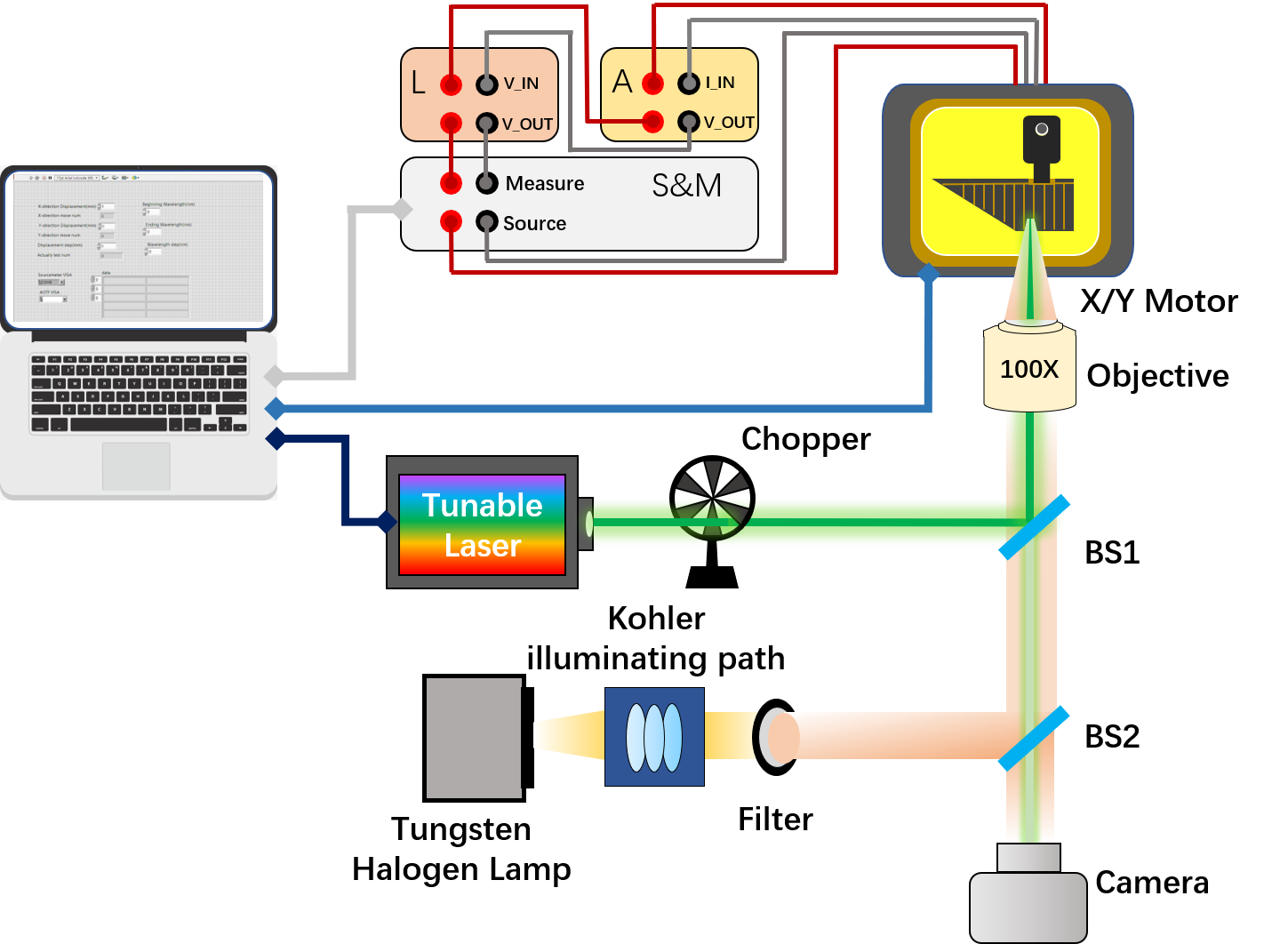
**Supplementary Fig. 4| Characterization of Ag@SiO2 core-shell nanostructure.** TEM images of the Ag nanospheres (a) and Ag@SiO2 core-shell nanostructure (b), (c) for different magnifications. Structural parameters analysis of Ag diameter (d) and SiO2 shell thickness (e). (f) The extinction spectra of Ag and Ag@SiO2 core-shell nanostructure.



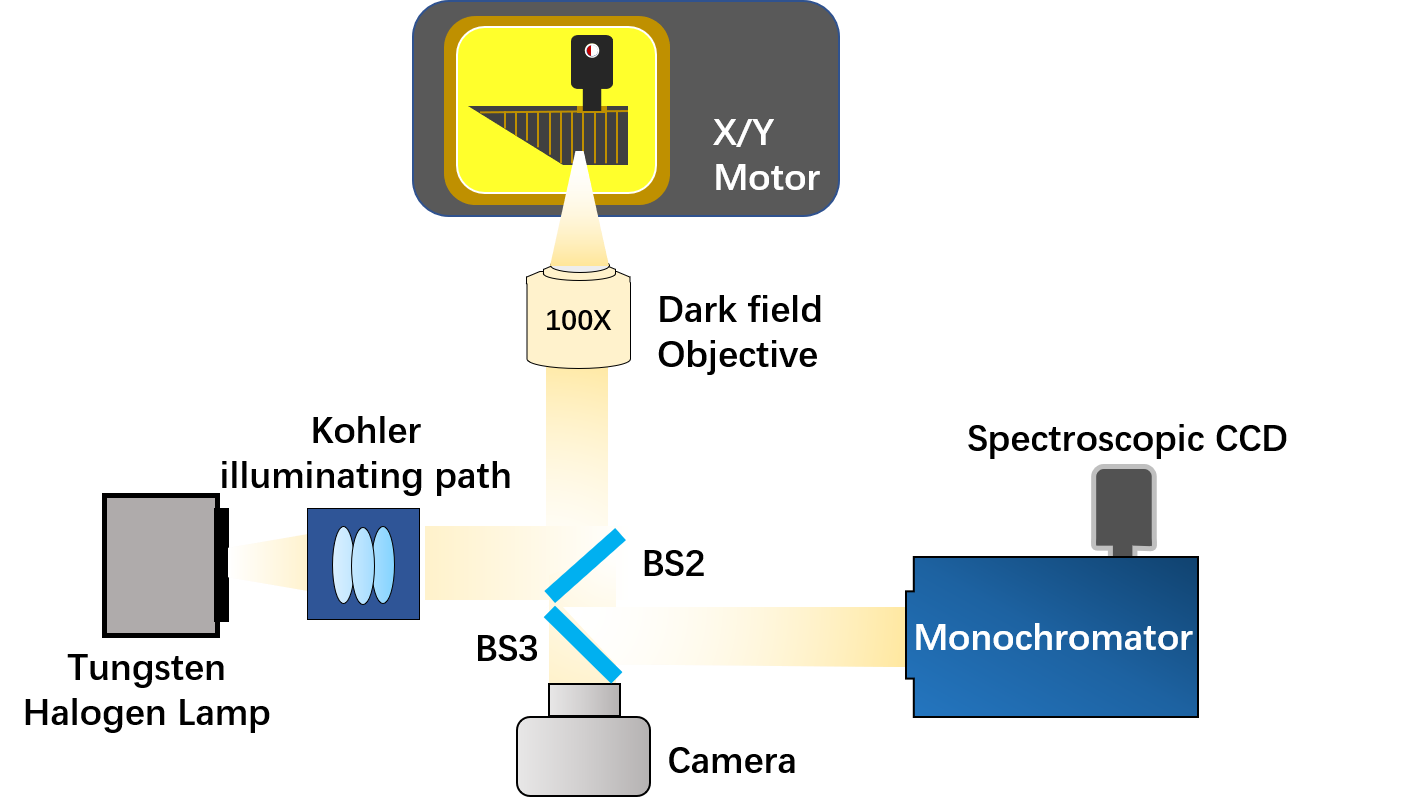
**Supplementary Fig. 5| Extra SEM Characterization of Ag@SiO2 core-shell nanostructure on InGaP-GaAs-Ge MJSC.** Regions near gird 1 min (a), 5 min (b), and 15 min (c). Large-area SEM image of different assembly time 1 min (d), 5 min (e), and 15 min (f).

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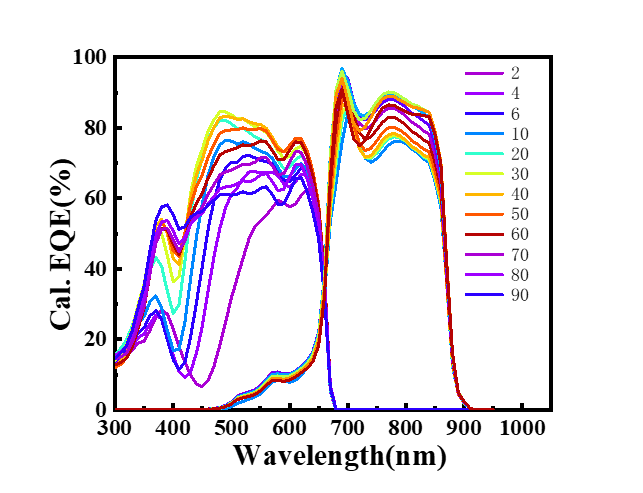
**Supplementary Fig. 6| Macro electrical performance of MJSC with self-assembly nanostructured layers.** **a** Relative variation of the short-circuit current density (*J*sc), the efficiency, the open-circuit voltage (*V*oc), and the fill factor for assembly times. Current relation(**b**) and Power-voltage relation (**c**) of InGaP-GaAs-Ge MJSCs with different self-assembly time. **d** Current density of the top cell and the middle cell under different assembly time. **e** Surface reflection spectra of MJSCs with different assembly time.**f** Relative reflectance variation normalized to the reference MJSC without a nanostructured layer.

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**Supplementary Fig. 7| Schematic of the micro-region photocurrent measurement system for MJSC**

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**Supplementary Fig. 8| Schematic of the micro-region optical characterization system for MJSC**

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**Supplementary Fig. 9| Calculated EQE for different shell thickness under the closely packed condition**

**Supplementary Table 1| Electrical parameters under AM1.5G illumination.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Description** | **Voc(V)** | **Jsc(mA/cm2)** | **Fill Factor(%)** | **Efficiency(%)** |
| 30 min | 2.56±0.01 | 10.80±0.09 | 84.43±0.26 | 23.36±0.15 |

**Supplementary Table 2| Micro background EQE analysis of MJSC.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Wavelength(nm)** | **Mean EQE relative Var. (%)** | **Max EQE relative Var. (%)** | **Min EQE relative Var. (%)** | **EQE relative Var. S.D.** |
| **450** | 0 | 1.63 | -2.03 | 0.98 |
| **480** | 0 | 1.72 | -2.10 | 0.72 |
| **500** | 0 | 1.16 | -0.74 | 0.39 |
| **520** | 0 | 0.55 | -0.57 | 0.29 |
| **540** | 0 | 0.50 | -0.20 | 0.26 |
| **600** | 0 | 0.45 | -0.37 | 0.23 |

**Supplementary Table 3| Micro EQE analysis of 5 minutes of self-assembly MJSC.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Wavelength(nm)** | **Mean EQE relative Var. (%)** | **Max EQE relative Var. (%)** | **Min EQE relative Var. (%)** | **EQE relative Var. S.D.** |
| **450** | 0.79 | 3.28 | -1.96 | 1.14 |
| **480** | 6.23 | 8.97 | 3.98 | 1.18 |
| **500** | 7.44 | 9.58 | 5.90 | 1.00 |
| **520** | 5.40 | 5.64 | 5.24 | 0.10 |
| **540** | 3.69 | 5.07 | 2.98 | 0.49 |
| **600** | 1.47 | 2.10 | 0.99 | 0.31 |