

Article

Synergistic Defect Management for Boosting the Efficiency of Cu(In,Ga)Se₂ Solar Cells

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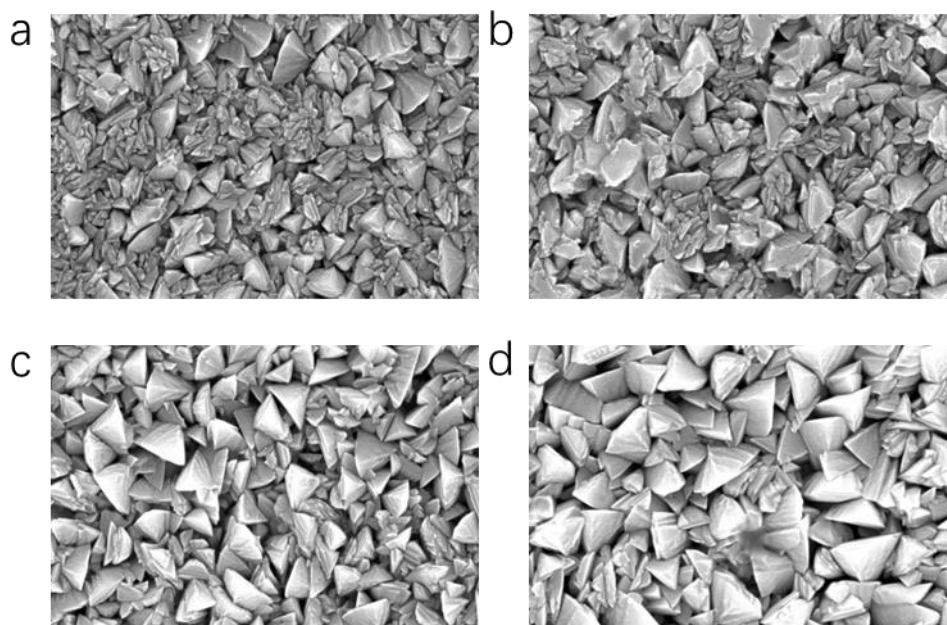


Figure S1. SEM surface topography of the CIGS absorption layers prepared at different sodium contents: (a) 0 %, (b) 3.5 %, (c) 7.5 %, and (d) 15 %

CdS process: The names of reagents used in this work for cadmium sulfide, reagent brands and chemical purity are shown in Table S1. The specific steps are as follows: (1) Configure the cadmium acetate solution at a concentration of 0.003 mol/L, sodium citrate solution at a concentration of 0.03 mol/L, and thiourea solution at a concentration of 0.25 mol/L in advance, and place them in a magnetic stirring device for 30 min stirring; (2) Place the samples to be prepared in deionized water and leave it for 10 min, to get rid of the particles on the surface and facilitate the CdS attachment; (3) Take 50 mL of deionized water, add 25 mL of cadmium acetate solution and 50 mL of ammonium acetate solution sequentially, mix well, and then place the sample with the sample baskets in a Beaker, and

then put the beaker into the water bath for preheating, preheating time for 10 min; (4) 25 mL of ammonia poured into the beaker, turn on the magnetic stirring; (5) 5 min later, you can see that the reaction solution is obviously yellow, the sample and the sample basket at the same time, remove the sample, placed in a beaker prepared in advance of the de-ionized water static for 2 min; (6) nitrogen will be blown dry on both sides of the sample. The thickness of the CdS layer can be adjusted by adjusting the reaction time in step 5.

Table S1 Information on the chemicals used in the preparation of CdS by CBD

Name	Chemical Formula	Brands	Purity
Cadmium acetate dihydrate	$\text{Cd}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$	Aladdin	99.99%
Sodium citrate dihydrate	$\text{C}_6\text{H}_5\text{Na}_3\text{O}_7 \cdot 2\text{H}_2\text{O}$	Aladdin	99%
Thiourea	$\text{CH}_4\text{N}_2\text{S}$	Aladdin	99%
Ammonia solution	H_5NO	Aladdin	>25% in H_2O

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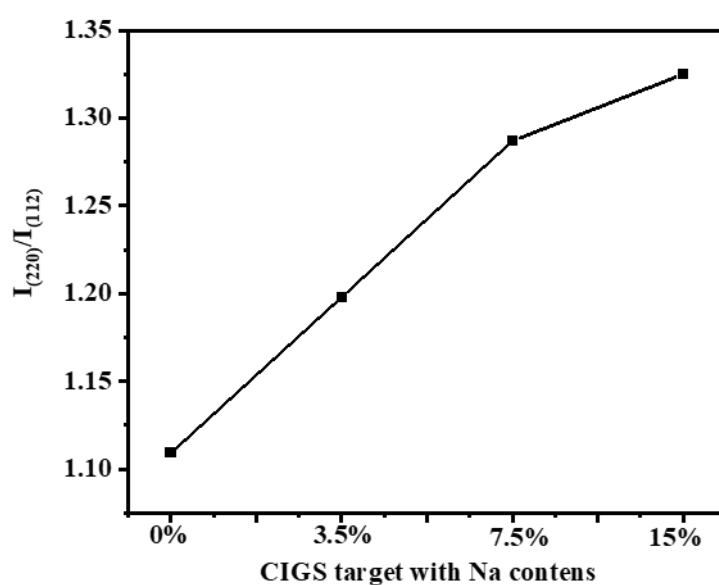


Figure S2. XRD patterns $I(220)/I(112)$ ratio increases with increasing target sodium

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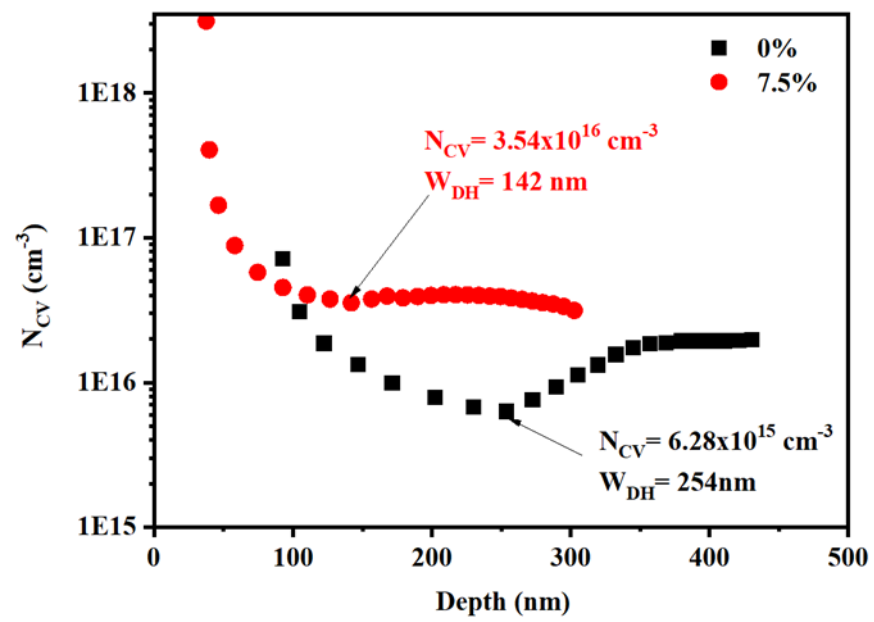


Figure S3. Net carrier concentration (N_{cv}) profiles of the CIGS solar cells with 0% and 7.5% Na contents

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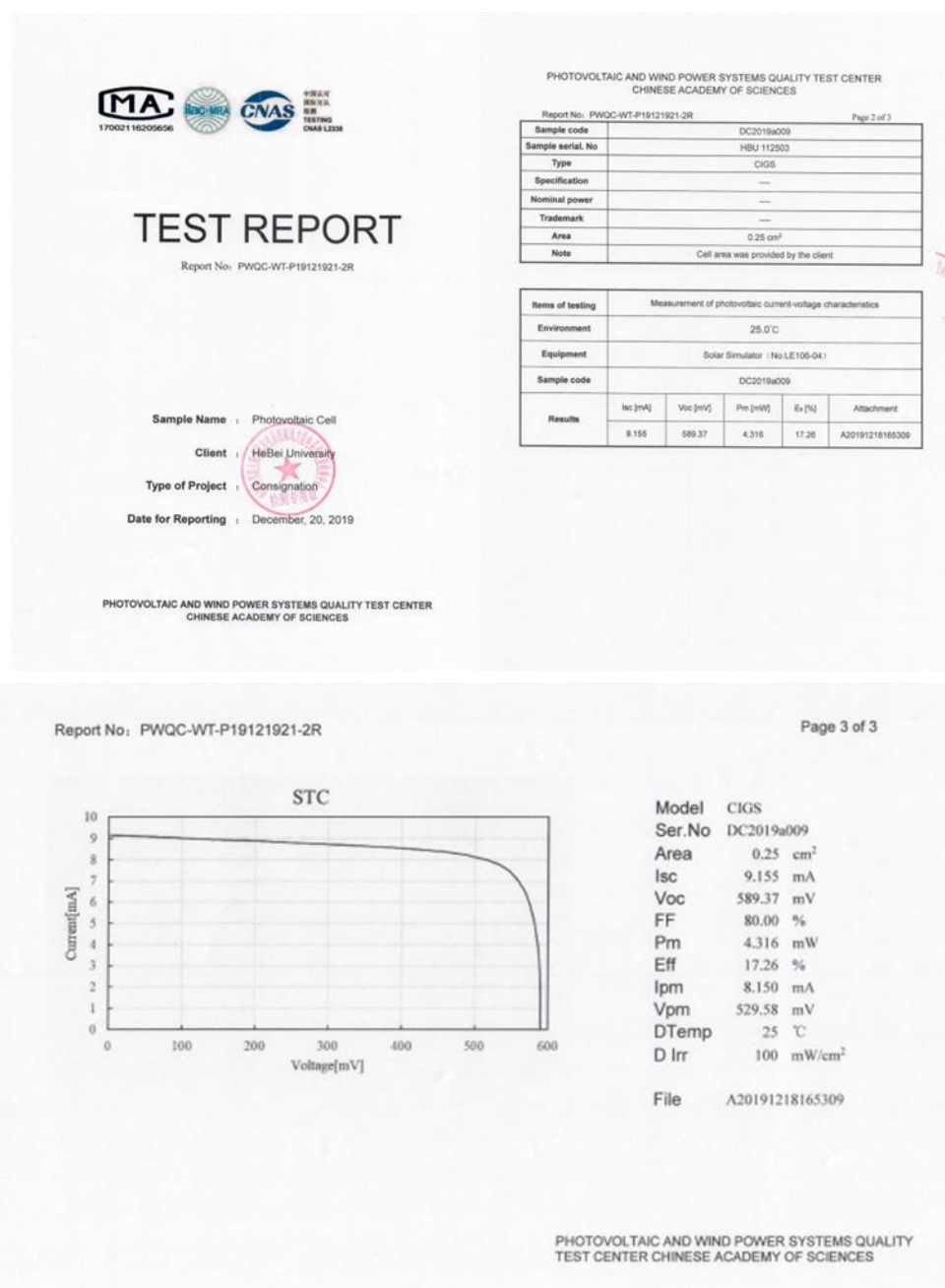


Figure S4. Certification report of the prepared CIGS solar cell in this paper. (Photovoltaic and Wind Power Systems Quality Test Center Chinese Academic of Sciences, No.6 Bei-er-tiao, Zhongguancun, Haidian district, Beijing, China)

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