

Process flow title			Revision
Danchip GreenBelt Solar cell process			2.3
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	Labmanager group GreenBelt	Batch name aug 2013	Date of creation 22-Nov-12
			Date of revision 15-Apr-13

Objective

Batch name: aug 2013

This process is used in Danchips UV-litho Green Belt course.


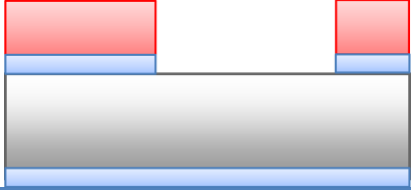


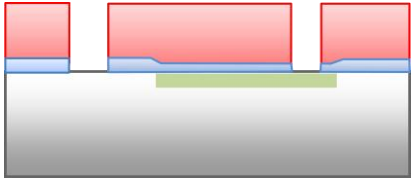

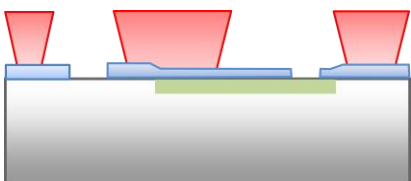
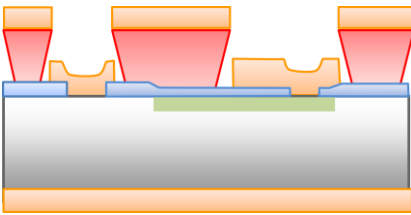
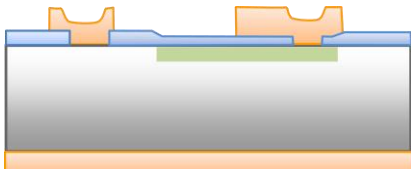
The purpose is to provide an example process flow and to educate Cleanroom users in general UV-lithographic techniques. The outcome is test-wafers with solar cells.

Substrates

Substrate	Orient.	Size	Doping/type	Polish	thickness	Box	Purpose	#	Sample ID
Silicon	<100>	4"	p(Boron)	SSP	525±25µm		Device wafers	6	S1-S25
Silicon	<100>	4"	p (Boron)	SSP	525±25µm		Test wafers	2	T1-T2
Silicon	<100>	4"	p (Boron)	SSP	525±25µm		Danchip test wafers	3	D1-D3

Comments:

Figures

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Comments: [Click here to enter text.](#)

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Step Heading	Equipment	Procedure	Comments
1 SiO₂ deposition			Wafer S1-S6, T1, D1
1.1 SiO ₂ dry oxidation	Boron Drive-in (A1)	Place a test wafer T1 and D1 in the center of the boat and place device wafers and eg. test wafers equally distributed on each side of the test wafer. No spacing between wafers. Recipe: Dry1050, time:180min Anneal: 20 min Target thickness: 150±10nm	Measure oxide thickness on D1 on the Filmtek and note the result in the furnace log and measurement sheet S1-S25 T1, D1
2 Lithography – 1.5µm standard			Wafer S1-S6
2.1 Surface treatment	HMDS oven	Load all wafers in oven for ~30 min Recipe: program 4	Note time in logbook
2.2 Clean spinner	SSE spinner	Clean spinner nozzle and run the dummy wafers Recipe: 1,5 4inch_Prox bake (Temp: 95°C, time:90 sec)	1-3 dummies Note time in logbook
2.3 Coat wafers	SSE spinner	Coat the backside of the device wafers 1.5 µm AZ5214e Novolac resist Recipe: 1,5 4inch_Prox bake (Temp: 95°C, time:90 sec)	Resist thickness not checked Note in logbook
2.4 Coat wafers	SSE spinner	Coat the front side of the device wafers 1.5 µm AZ5214e Novolac resist Soft bake on hotplate Recipe: 1,5 4inch_Prox bake (Temp: 95°C, time:90 sec)	Resist thickness not checked Note time in logbook
2.5 Exposure	Aligner-6inch	Align mask to wafer flat. Hard contact Recipe: Greenbelt -1_5um-flat Exposure time: 3 sec Mask: N+ (dark field)	Note time in logbook
2.6 Develop	Developer bench	Develop in AZ 351B for 60±10 sec	Note time in logbook
2.7 Rinse/dry	Wet bench/ Spin dryer	Rinse in DI water for 5 min (300±30 sec). Spin dry	
2.8 Inspection	Optical microscope	Check pattern and alignment marks	Note in measurement sheet
3 SiO₂ etch			Wafer S1-S6
3.1 SiO-etch	SiO-etch	Etching rate: 75-80 nm/min Time: 2-2½ min	SiO-etch is BHF with surfactant
3.2 Rinse/dry	Wet bench/ Spin dryer	Rinse in DI water for 5 min (300±30 sec). Spin dry	
3.3 Inspection	Optical microscope	Check pattern and alignment marks	
3.4 Strip resist	Acetone	First 2-3 min in rough followed by 5 min in fine strip bath with US	
3.5 Rinse/dry	Wet bench/ Spin dryer	Rinse in DI water for 5 min (300±30 sec). Spin dry	
3.6 Inspection	Dektak	Measure step height Target: 150±10 nm	Note in measurement sheet
4 Phosphor Pre-deposition			
4.1 RCA clean	RCA bench	Follow standard procedure but without HF dip.	No HF Wafer S1-S6,T1

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Step Heading	Equipment	Procedure	Comments
4.2 Phosphor pre-deposition	Phosphor pre-dep furnace (POCL)	Place a p-type test wafer D2 in the center of the boat and place device wafers equally distributed on each side of the test wafer. On each side of the wafers place two p-type test wafers T1 and T2. No spacing between wafers. Front-side to the left. Recipe: 900, time 15 min Anneal: 20 min Target doping : $R_{\square}=40 \Omega/\square$	Note diffusion time in logbook Wafer S1-S6, T1, T2, D2
4.3 Etch of phosphor glass	BHF in RCA bench for doped wafers	Time: 30 sec Removes all phosphor glass and only some of the dry oxide	Wafer S1-S6, T1, T2, D2 Measure resistivity on D2 using four point probe and note resistivity for D2 in furnace logbook.
4.4 SiO2 dry oxidation	Phosphor Drive-in (A3)	Place a test wafer in the center of the boat and place device wafers and eg. test wafers equally distributed on each side of the test wafer. No spacing between wafers. Front-side to the left. Recipe: Dry1050, time:70 min Target thickness: $90\pm 10\text{nm}$	Wafer S1-S6, T1, T2, D3 Measure oxide thickness on T1 (ca. 77+80nm), T2 (ca. 90 nm) and D3(ca. 80 nm) on the Filmtek and note the result in the furnace log for D3 and in measurement sheet for T1, T2 and D3.
4.5 Etch oxide	BHF	Etch oxide on test wafer T2 (ca 150 nm) Etch oxide on test wafer T3 (N+) (ca 90 nm)	Wafer T1, T2 Measure resistivity and on T1 and T2 using four point probe. Note resistivity in measurement sheet. Note the wafer becomes hydrophobic.
4.6 Inspection	Optical microscope	Check alignment marks on device wafers	
5 Lithography – 1.5μm standard			Wafer S1-S6
5.1 Surface treatment	HMDS oven	Load all wafers in oven for ~30 min Recipe: program 4	Note time in logbook
5.2 Clean spinner	SSE spinner	Clean spinner nozzle and run the dummy wafers Recipe: 1.5 4inch	1-3 dummies Note time in logbook
5.3 Coat wafers	SSE spinner	Coat the device wafers 1.5 μm AZ5214e Novolac resist Soft bake on hotplate Recipe: 1.5 4inch (Temp: 90°C, time:90 sec)	Resist thickness not checked Note time in logbook
5.4 Exposure	Aligner-6inch	Align to alignment marks on wafer Target < 2 μm Hard contact Recipe: Greenbelt-1_5um_Contacts Exposure time: 3 sec Mask: CONTACTS (dark field)	Note time in logbook

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Step Heading	Equipment	Procedure	Comments
5.5 Develop	Developer bench	Develop in AZ 351B for 60±10 sec	Note time in logbook
5.6 Rinse/dry	Wet bench/ Spin dryer	Rinse in DI water for 5 min (300±30 sec). Spin dry	
5.7 Inspection	Optical microscope	Check pattern and alignment	Note in measurement sheet.
6 SiO₂ etch			Wafer S1-S6
6.1 SiO-etch	SiO-etch	Etching rate: 75-80 nm/min Time: 2-2½ min	Use etching time from step 4.5 on test wafer T1 (ca 150nm oxide). Note that the backside becomes hydrophobic
6.2 Rinse/dry	Wet bench/ Spin dryer	Rinse in DI water for 5 min (300±30 sec). Spin dry	
6.3 Inspection	Optical microscope	Check pattern and alignment	
6.4 Strip resist	Acetone	First 2-3 min in rough followed by 5 min in fine strip bath with US	
6.5 Rinse/dry	Wet bench/ Spin dryer	Rinse in DI water for 5 min (300±30 sec). Spin dry	
6.6 Inspection	Dektak	Measure step height Target: 90±10 nm in N+ areas Target: 130±10 nm in un-doped areas	Note step heights in measurement sheet.
7 Lithography – 2.2µm image reversal			Wafer S1-S6
7.1 Surface treatment	HMDS oven	Load all wafers in oven for ~30 min Recipe: program 4	Note time in logbook
7.2 Clean spinner	SSE spinner	Clean spinner nozzle and run the dummy wafers Recipe: 2.2 4inch	1-3 dummies Note time in logbook
7.3 AZ5214 resist coating	SSE spinner	Coat the device wafers 2.2 µm AZ5214e Novolac resist Recipe: 2.2 4inch (Temp: 90°C, time:90 sec)	Resist thickness not checked Note time in logbook
7.4 Exposure	Aligner-6inch	Align to alignment marks on wafer. Hard contact. Recipe: Greenbelt -2_2um-rev Exposure time: 1.7 sec Mask: METAL (clear field)	Note time in logbook
7.5 Reverse bake	SSE spinner	Recipe:4inch reverse bake Temp: 110 °C Time: 120 sec	Alternatively use hotplates
7.6 Flood exposure	Aligner-6inch	Recipe: GreenBelt_Flood-exposure-15s Exposure time: 15 sec Mask: none	Note time in logbook
7.7 Transport of wafers	transport box	Load wafers into the Black or blue transport box	To avoid unwanted exposure from the white light
7.8 Develop	Developer bench	Develop in 70±10 sec	Note time in logbook
7.9 Rinse/dry	Wet bench/ Spin dryer	Rinse in DI water for 5 min (300±30 sec). Spin dry	
7.10 Inspection	Optical microscope	Alignment check	Note in measurement sheet.

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Step Heading	Equipment	Procedure	Comments
8 Aluminum pattern			Wafer S1-S6
8.1 Aluminum deposition	Alcatel	Metal: Al Thickness: 300 nm	Note time in logbook
8.2 Aluminum deposition on back side	Alcatel/ Wordentec	Metal: Al Thickness: 200 nm	Note time in logbook
8.3 Lift-off	Lift-off bench	Leave wafers in acetone for 2-3 min. Start the US for 10 min. Rotate wafers and start US for another 10 min.	Fill the bench with Acetone until carrier is covered.
8.4 Rinse/dry	Wet bench/ Spin dryer	Rinse in DI water for 5 min (300±30 sec). Spin dry	
8.5 Inspection	Optical microscope	Check for completeness	
8.6 Inspection	Dektak 4pp	Measure thicknesses (on front and back) Measure metal sheet resistance on backside	Note in measurement sheet Note in measurement sheet

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