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| Objective |
| Batch name: aug 2012 |
| 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. |

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| Substrates | | | | | | | | | | | |
| Substrate | Orient. | Size | | Doping/type | Polish | thickness | Box | Purpose | # | Sample ID | |
| Silicon | <100> | | 4” | p(Boron) | SSP | 525±25µm |  | Device wafers | 25 | | 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:

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| Step Heading | Equipment | Procedure | Comments |
| 1. SiO2 deposition | | | **Wafer** **S1-S25, T1, D1** |
| * 1. RCA clean | RCA Bench | Follow standard procedure | S1-S25  T1, D1 |
| * 1. SiO2 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 |
| 1. Lithography – 1.5µm standard | | | **Wafer** **S1-S25** |
| * 1. Surface treatment | HMDS oven | Load all wafers in oven for ~30 min  Recipe: program 4 | Note time in logbook |
| * 1. 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 |
| * 1. Coat wafers | SSE spinner | Coat the backside of the device wafers  1.5 m AZ5214e Novolac resist  Recipe: 1,5 4inch\_Prox bake (Temp: 95°C, time:90 sec) | Resist thickness not checked Note in logbook |
| * 1. Coat wafers | SSE spinner | Coat the front side of the device wafers  1.5 m 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 |
| * 1. 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 |
| * 1. Develop | Developer bench | Develop in AZ 351B for 60±10 sec | Note time in logbook |
| * 1. Rinse/dry | Wet bench/ Spin dryer | Rinse in DI water for 5 min (300±30 sec).  Spin dry |  |
| * 1. Inspection | Optical microscope | Check pattern and alignment marks | Note in measurement sheet |
| 1. SiO2 etch | | | **Wafer** **S1-S25** |
| * 1. SiO-etch | SiO-etch | Etching rate: 75-80 nm/min  Time: 2-2½ min | SiO-etch is BHF with surfactant |
| * 1. Rinse/dry | Wet bench/ Spin dryer | Rinse in DI water for 5 min (300±30 sec).  Spin dry |  |
| * 1. Inspection | Optical microscope | Check pattern and alignment marks |  |
| * 1. Strip resist | Acetone | First 2-3 min in rough followed by 5 min in fine strip bath with US |  |
| * 1. Rinse/dry | Wet bench/ Spin dryer | Rinse in DI water for 5 min (300±30 sec).  Spin dry |  |
| * 1. Inspection | Dektak | Measure step height  Target: 150±10 nm | Note in measurement sheet |
| Step Heading | Equipment | Procedure | Comments |
| 1. Phosphor Pre-deposition | | |  |
| * 1. RCA clean | RCA bench | Follow standard procedure but without HF dip. | No HF  **Wafer S1-S25,T1, T2, D2, D3** |
|  |  |  |  |
| * 1. 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□=40 Ω/□ | Note diffusion time in logbook  **Wafer S1-S25, T1, T2, D2** |
| * 1. 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-S25, T1, T2, D2**  Measure resistivity on D2 using four point probe and note resistivity for D2 in furnace logbook. |
| * 1. 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±10nm | **Wafer S1-S25, 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. |
| * 1. 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. |
| * 1. Inspection | Optical microscope | Check alignment marks on device wafers |  |
| 1. Lithography – 1.5µm standard | | | **Wafer S1-S3** |
| * 1. Surface treatment | HMDS oven | Load all wafers in oven for ~30 min  Recipe: program 4 | Note time in logbook |
| * 1. Clean spinner | SSE spinner | Clean spinner nozzle and run the dummy wafers  Recipe: 1.5 4inch | 1-3 dummies  Note time in logbook |
| * 1. Coat wafers | SSE spinner | Coat the device wafers  1.5 m 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 |
| * 1. 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 |
| Step Heading | Equipment | Procedure | Comments |
| * 1. Develop | Developer bench | Develop in AZ 351B for 60±10 sec | Note time in logbook |
| * 1. Rinse/dry | Wet bench/ Spin dryer | Rinse in DI water for 5 min (300±30 sec).  Spin dry |  |
| * 1. Inspection | Optical microscope | Check pattern and alignment | Note in measurement sheet. |
| 1. SiO2 etch | | | **Wafer S1-S3** |
| * 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 |
| * 1. Rinse/dry | Wet bench/ Spin dryer | Rinse in DI water for 5 min (300±30 sec).  Spin dry |  |
| * 1. Inspection | Optical microscope | Check pattern and alignment |  |
| * 1. Strip resist | Acetone | First 2-3 min in rough followed by 5 min in fine strip bath with US |  |
| * 1. Rinse/dry | Wet bench/ Spin dryer | Rinse in DI water for 5 min (300±30 sec).  Spin dry |  |
| * 1. 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. |
| 1. Lithography – 2.2µm image reversal | | | **Wafer S1-S3** |
| * 1. Surface treatment | HMDS oven | Load all wafers in oven for ~30 min  Recipe: program 4 | Note time in logbook |
| * 1. Clean spinner | SSE spinner | Clean spinner nozzle and run the dummy wafers  Recipe: 2.2 4inch | 1-3 dummies  Note time in logbook |
| * 1. AZ5214 resist coating | SSE spinner | Coat the device wafers  2.2 m AZ5214e Novolac resist  Recipe: 2.2 4inch (Temp: 90°C, time:90 sec) | Resist thickness not checked  Note time in logbook |
| * 1. 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 |
| * 1. Reverse bake | SSE spinner | Recipe:4inch reverse bake  Temp: 110 °C  Time: 120 sec | Alternatively use hotplates |
| * 1. Flood exposure | Aligner-6inch | Recipe: GreenBelt\_Flood-exposure-15s  Exposure time: 15 sec  Mask: none | Note time in logbook |
| * 1. Transport of wafers | transport box | Load wafers into the Black or blue transport box | To avoid unwanted exposure from the white light |
| * 1. Develop | Developer  bench | Develop in 70±10 sec | Note time in logbook |
| * 1. Rinse/dry | Wet bench/ Spin dryer | Rinse in DI water for 5 min (300±30 sec).  Spin dry |  |
| * 1. Inspection | Optical microscope | Alignment check | Note in measurement sheet. |
| Step Heading | Equipment | Procedure | Comments |
| 1. Aluminum pattern | | | **Wafer S1-S3** |
| * 1. Aluminum deposition | Alcatel | Metal: Al  Thickness: 300 nm | Note time in logbook |
| * 1. Aluminum deposition on back side | Alcatel/ Wordentec | Metal: Al  Thickness: 200 nm | Note time in logbook |
| * 1. 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. |
| * 1. Rinse/dry | Wet bench/ Spin dryer | Rinse in DI water for 5 min (300±30 sec).  Spin dry |  |
| * 1. Inspection | Optical microscope | Check for completeness |  |
| * 1. 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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