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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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| Figures |
|  |  |  |  |
| Figure | Caption | Step | Figure |
|  | After SiO2 growth | 1.2 |  |
|  | After lithography and SiO2 etch in BHF | 3.3 |  |
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|  | After metal deposition | 8.1 |  |
|  | After lift-off | 8.3 |  |

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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-S25T1, 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:180minAnneal: 20 min Target thickness: 150±10nm | Measure oxide thickness on D1 on the Filmtek and note the result in the furnace log and measurement sheetS1-S25T1, D1 |
| 1. Lithography – 1.5µm standard
 | **Wafer** **S1-S25** |
| * 1. Surface treatment
 | HMDS oven | Load all wafers in oven for ~30 minRecipe: program 4 | Note time in logbook |
| * 1. Clean spinner
 | SSE spinner | Clean spinner nozzle and run the dummy wafersRecipe: 1,5 4inch\_Prox bake (Temp: 95°C, time:90 sec) | 1-3 dummiesNote time in logbook |
| * 1. Coat wafers
 | SSE spinner | Coat the backside of the device wafers 1.5 m AZ5214e Novolac resistRecipe: 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 wafers1.5 m AZ5214e Novolac resistSoft 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 contactRecipe: Greenbelt -1\_5um-flatExposure time: 3 secMask: 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/minTime: 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 heightTarget: 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 minAnneal: 20 minTarget 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 secRemoves 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 minTarget 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 minRecipe: program 4 | Note time in logbook |
| * 1. Clean spinner
 | SSE spinner | Clean spinner nozzle and run the dummy wafersRecipe: 1.5 4inch | 1-3 dummiesNote time in logbook |
| * 1. Coat wafers
 | SSE spinner | Coat the device wafers1.5 m AZ5214e Novolac resistSoft bake on hotplate Recipe: 1.5 4inch (Temp: 90°C, time:90 sec) | Resist thickness not checkedNote time in logbook |
| * 1. Exposure
 | Aligner-6inch | Align to alignment marks on wafer Target < 2 µmHard contactRecipe: Greenbelt-1\_5um\_ ContactsExposure time: 3 secMask: 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/minTime: 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 heightTarget: 90±10 nm in N+ areasTarget: 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 minRecipe: program 4 | Note time in logbook |
| * 1. Clean spinner
 | SSE spinner | Clean spinner nozzle and run the dummy wafersRecipe: 2.2 4inch | 1-3 dummiesNote time in logbook |
| * 1. AZ5214 resist coating
 | SSE spinner | Coat the device wafers2.2 m AZ5214e Novolac resistRecipe: 2.2 4inch (Temp: 90°C, time:90 sec) | Resist thickness not checkedNote time in logbook |
| * 1. Exposure
 | Aligner-6inch | Align to alignment marks on wafer. Hard contact.Recipe: Greenbelt -2\_2um-revExposure time: 1.7 secMask: METAL (clear field) | Note time in logbook |
| * 1. Reverse bake
 | SSE spinner | Recipe:4inch reverse bakeTemp: 110 °CTime: 120 sec | Alternatively use hotplates |
| * 1. Flood exposure
 | Aligner-6inch | Recipe: GreenBelt\_Flood-exposure-15sExposure time: 15 secMask: 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
 | Developerbench | 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: AlThickness: 300 nm  | Note time in logbook |
| * 1. Aluminum deposition on back side
 | Alcatel/ Wordentec | Metal: AlThickness: 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
 | Dektak4pp | Measure thicknesses (on front and back)Measure metal sheet resistance on backside | Note in measurement sheetNote in measurement sheet |

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