DEVELOPMENT OF HIGH EFFICIENCY BACK PASSIVATED SILICON SOLAR CELLS WITH SCREEN PRINTED CONTACTS

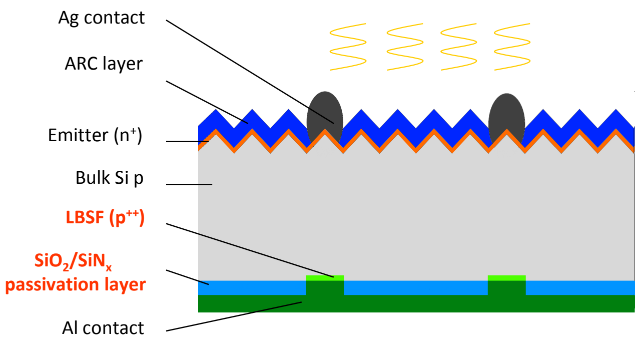
L.BOUNAAS [a,*], N.AURIAC [a], B.GRANGE [a], J.JOURDAN [b], S.MIALON [b], R. MONNA [a], S.DE MAGNIENVILLE [b], M.PASQUINELLI [c]

[a]CEA, LITEN, INES, 73377 Le Bourget du Lac, France [b]MPO Energy, Domaine de Lorgerie, 53700, Averton, France

[c]IM2NP - Université Aix-Marseille III UMR 6242, 13397 Marseille, France [*]Corresponding author : lotfi.bounaas@cea.fr

1. Scope of this work

LBSF solar cell architecture (*Local Back Surface Field*)



Advantages of LBSF structures / Full Al-BSF

- ✓ Better passivation
- ✓ Better light trapping

} η ↗

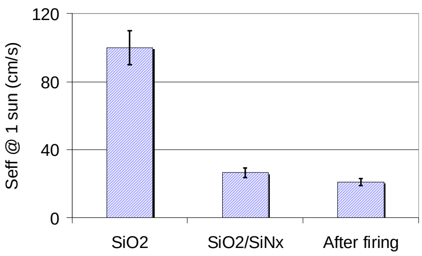
Aim of this study

- ✓ Development of high efficiency LBSF solar cells
- ✓ ↘ rear SRV for optimal passivation
- ✓ Optimization of the laser dielectric layer opening
- ✓ Simulation of the point contact pattern
- ✓ Comprehensive study of the detrimental effects driving the efficiency at cell level

Process flow of LBSF solar cells

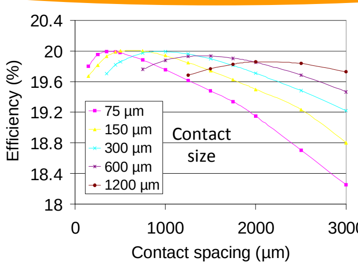
- Rear side polishing
- Front side texturization
- Back side passivation SiO_2/SiN_x
- Emitter diffusion
- Back side laser ablation
- Front side ARC
- Front and Back side screen-printing
- Co-firing

2. Results and discussion



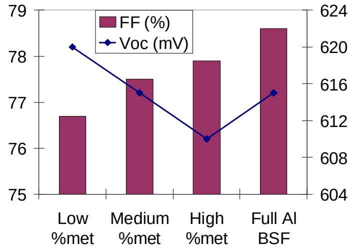
Surface passivation

- ✓ Low SRV provided by SiO_2/SiN_x
- ✓ Good firing stability of the dielectric stack



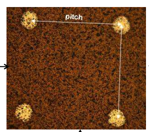
LBSF structure 2D simulation

- ✓ Optimization of the contact spacing/size
- ✓ Best η with 350 µm spacing (75µm wide contact)

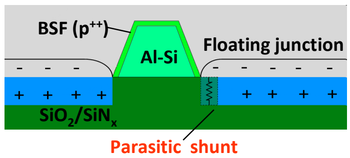


Electrical cell I-V parameters

- ✓ High FF (>78%) performed with LBSF structure
- ✓ Simulation trends experimentally verified
- ✓ Low Voc measured on cells ≠ passivation isssues

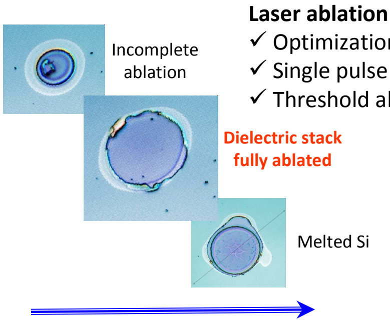


Optimized laser contact opening pattern



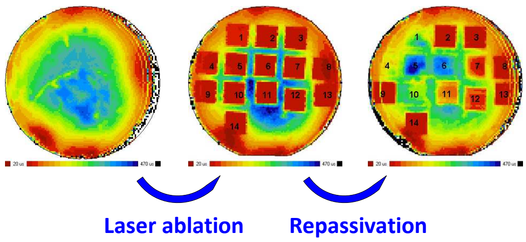
« Parasitic » shunting

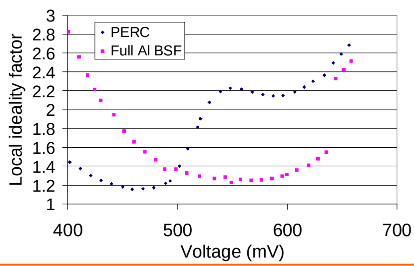
- ✓ Related to a shunted floating junction (+ charge)
- ✓ Detrimental effect highlighted with dark-IV curves



Laser ablation

- ✓ Optimization of the laser ablation parameters
- ✓ Single pulse to qualitatively evaluate the ablation
- ✓ Threshold ablation fluence determined with lifetime mappings





3. Conclusions & work in prospect

- Development of the LBSF solar cell structure based on optimized surface passivation/laser ablation/2D simulation
- Electrical I-V results highlighting the detrimental effect of parasitic shunts
- Future work will focus on the implementation of alternative dielectric back passivation layers to reach efficiencies higher than 19%