Interface studies on laser structured plated solar cells

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MOTIVATION
- High requirement for plated contacts on high efficient solar cells
- Electrical and mechanical properties are determined on the contact interface
- Goal: Improvement of laser structured plated contacts by improved understanding of the interface

TOPCon CELL WITH PLATED CONTACTS: 22.9 %
- 10x10cm² TOPCon cells with lasersstructured plated contacts
- 5 μm laser contact opening width, 3 busbar, 1.3mm finger pitch

DIRECT PLATING ON LASER STRUCTURED SILICON
- Process sequence at Fraunhofer ISE for laser-structured plated contacts

CONTACT RECOMBINATION
- Influence of laser damage depends on doping profile
- To minimize loss
  - Laser parameters
  - Selective emitter
  - Annealing of LCO
- Plated TOPCon solar cell:
  - J0, laser : 2700 fA/cm²
  - Total J0 : 59 fA/cm²
  - To lower damage: Adjust emitter profile to penetration depth

AVOIDING PARASITIC PLATING
- Parasitic plating (PP) for ARC defects
- Harms aesthetic, pFF, Voc and Jsc
- PP can be suppressed by
  - Avoiding ARC defects
  - Electrical Insulation of ARC defects
  - Skipping HF (“Easy Plating”)
- Easy Plating: allows good contact resistance without HF-dip
  - Limited time between ablation and deposition
  - Post-Plating anneal required
  - No effect of silicidation

ENSURING CONTACT ADHESION
- Two established ways to ensure adhesion
  - Mechanical solution: Topography
  - Chemical solution: Silicidation
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  - Necessary: Removal of all interface oxides
  - Risk of nickel spiking (pFF-loss)
- Topography
  - Ps-fs-pulsed laser ablation on textured surface
  - Rougening of contact opening (first 50-200nm → emitter!)

CONCLUSION
- Low contact resistivity on lowly doped emitters without silicide formation
- Emitter profile and penetration depth of laser need to be adjusted
- To avoid parasitic plating: no ARC defects or skipping HF-dip
- For contact adhesion: Ensure nano-roughness or silicides

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