Company Introduction and R&D Activities

Fill Factory s.r.o.

Rožnov pod Radhoštěm, Czech Republic
28.8.2014
Location of Fill Factory s.r.o.

Headquater
- Czech Republic
- Rožnov pod Radhoštěm
Roznov pod Radhostem

From Prague – 350km

From Wien – 300km
Industrial area
Background

✓ **Fill Factory s.r.o.** (www.fillfactory.cz) is a new SME established in July 2014 by employees of the Solartec company focusing on crystalline silicon solar cell and special PV module design and production.

✓ **Solartec s.r.o.** (www.solartec.cz) is a company now focusing only on design, installation and monitoring PV power plants and all the activities related to the solar cell process development and subsequent production according to requirements of its clients (various sizes, shapes, colours, concentration ratios, contact structures, optical sensors) were transform to the new subject – Fill Factory - including all key persons and nearly all other employees.

✓ Collaboration between both companies still exists mainly in the PV module design and production based on business contract.

✓ The key persons of Fill Factory (working in Solartec over 15 years) have wide experience not only in the wafer based solar cell technology but also in R&D area achieved during collaboration within nationally-funded projects in Czech Republic (all together more than 15 projects) as well as EU founded projects focused on concentrator solar cells and improved designs of the Si wafer and PV module technology.
Basic Data

✓ Established: July 2014
✓ Place of Business: Rožnov pod Radhoštěm, Czech Republic
✓ Legal Form: private limited company (s.r.o.)
✓ Shareholders and executives: Radim Bařinka – 1/3
✓                      Aleš Poruba – 1/3
✓                      Jiří Hladík – 1/3
✓ Basic Capital: 99.999 CZK (3.604 EUR)
✓ Staff: 9 persons
✓ Production, lab and office area: 1.343 sqm of rented space
✓ Business Branch: production, services and sale
Staff

- **Radim Bařinka** – 20 years in PV, co-owner, executive, CEO, PVD
- **Aleš Poruba** – 20 years in PV, co-owner, executive, R&D, diagnostic methods
- **Jiři Hladík** – 8 years in PV, co-owner, executive, products, structuring, PV modules
- **Pavel Čech** – 10 years in PV, solar cells production, screen printing, structuring
- **Pavlína Bařinková** – 8 years in PV, administration, wet chemical processes
- **Martin Kusko** – 6 years in PV, high temperature processes, cutting
- **Lubomír Pečiva** – designing, construction, maintenance, PV modules
- **Alena Barošová** – administration, processing
- **Danuše Koňaříková** - processing
Key Activities

Solar Cell Production

PV Modules Production

Services

R&D Projects
Products

✓ Solar Cells
  ✓ Standard c-Si based SC
  ✓ Customized SC
    ✓ Solar cells of various shape and size
    ✓ Colored SC
    ✓ CPV
    ✓ Solar cells with various metallization pattern
  ✓ Alternative solar cell structures – selective emitter, bifacial cells, semitransparent cells, MWT, ...

✓ PV Modules
  ✓ Customized PV Modules
  ✓ BIPV
    ✓ Facades
    ✓ PV insulated glass
  ✓ PV Mosaics

✓ Services
  ✓ Characterization of materials, surfaces and semiconductor structures
  ✓ Evaluation of processing materials
  ✓ Designing and assembling of tools and equipments
### Current technical and technology background

#### Diagnostic tools for defect recognition
- Lifetime measurement - MWPCD and QSSPC
- Sun simulators for solar cells
- Electroluminescence
- LBIC – new tool
- IR camera
- Shunt detection
- LID measurement
- Surface analysis
- EQE/R measurement

#### Solar cells processing
- Batch type processes
- Wet chemical processes
- Diffusion/gettering - POCl₃ and BBr₃
- ARC deposition - LPCVD, PECVD, sputtering
- Metallization - screen printing, plating and electroplating
- Laser processes

#### Module production
- Manual interconnection with conductive adhesives
- Encapsulating methods currently
  - Lamination
  - Liquid resins
Processes for solar cells production

- Wet chemical processes (SDE, alkaline and acidic texturing, cleaning,...)
- High temperature processes - annealing, oxidation, $\text{POCl}_3$ and $\text{BBr}_3$ diffusion, LPCVD and PECVD $\text{SiN}_x / \text{SiO}_2 / \text{Al}_2\text{O}_3$ deposition, RTA, IR belt furnace)
- Photolithography (limited to 4” wafers)
- Sputtering (Ti, Al, $\text{SiN}_x$, $\text{SiO}_2$, $\text{Al}_2\text{O}_3$, AlN)
- Screen printing (metallic pastes Ag, Al, AgAl; etching pastes)
- Laser structuring processes (edge isolation, ablation, drilling, grooving)
- Electroplating (acidic Cu, Ni, Sn and alkaline Cu, Ag)
- Electroless plating (nickel)
- Plasma etching
- Testing & sorting under STC (continuous Xe arc lamp)
- Solar cell cutting (diamond wheel saw and laser)
Standard solar cells

- Crystalline silicon solar cells
  - monocristalline silicon
  - multicristalline silicon
- Doping: p-type (boron)
- Wafer shapes
  - pseudosquare for mono
  - full square for multi
- Standard wafer sizes
  - 5” - 125 x 125 mm
  - 6” - 156 x 156 mm
- Structured surface
  - SDE
  - Alkaline texturing
  - Acidic texturing
- Front side junction
- Front side ARC and passivation
- Both side contacts
- All screen printed metallization
- Al BSF structure on rear side
- Efficiency
  - mono – up to 18,5%
  - multi – up to 17,5%
Current production conditions

- Batch type of processing with manual operation
- Current production capacity
  - 6,500 pcs per month (normal operation)
  - up to 3,000 pcs per week (express processing)
- Type of material
  - Monocrystalline wafers
  - Multicrystalline wafers
  - Mono-like wafers
- Wafer shape and size
  - 4” - round / 100 mm
  - 4” - PSQ / 102,5 x 102,5 mm
  - 5” - FSQ, PSQ / 125 x 125 mm
  - 6” - FSQ, PSQ / 156 x 156 mm
- Structures
  - Al BSF solar cell
  - Selective emitter
PV modules
PV module assembling

- Manual interconnection with conductive adhesives
- Interconnection method
  - Tabbing/stringing
  - Shingling
  - Mounting on PCB
- Various module structures with selectable appearance
- Maximum module size: 3.800 x 1.500 mm
- Module parameters measurement by flash tester
PV modules – basic types

- Glass/glass lamination
- Semitransparent insulated glazing
- Resin application
- Backsheet foils
- Non transparent back side plates (PCB, Eternit, composites, ..)
Characterization tools

✓ Lifetime measurement – µPCD(Semilab), QSSCP (Sinton)
✓ Sun-Voc measurement
✓ Electroluminescence / photoluminescence
✓ Sheet resistance mapping (4PP, contactless)
✓ IV measurements for solar cells
✓ LBIC analyses (4 wavelengths)
✓ EQE/R measurement
✓ Digital optical microscopy, AFM
✓ Surface profilometry
✓ Optical measurement (ellipsometry)
✓ Metallic contact features – Reimer technique
✓ Noise characterization
✓ Surface tension analysis
✓ Thermography
Research & Development

✔ EU & Czech National Projects
  ✔ Colored solar cells
  ✔ Laser processes in SC production
  ✔ CVD and PVD passivation and ARC layers
  ✔ Solar cells production processes for UMG silicon
  ✔ Automated in-line silicon solar cells reparation based on laser processing
  ✔ Mathematical modeling of high temperature processes
  ✔ Systems for accumulation of electricity from RES
  ✔ High efficiency concepts – n-type, HJ, back side contacts
  ✔ Innovative structures of PV modules

✔ Innovative PV Products
  ✔ Enhanced Colored Solar Cells
  ✔ PV Street Lights
  ✔ Hybrid PV+PT Concentration Systems
  ✔ Concentration PV Cells
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