Company-Presentation

公司介绍

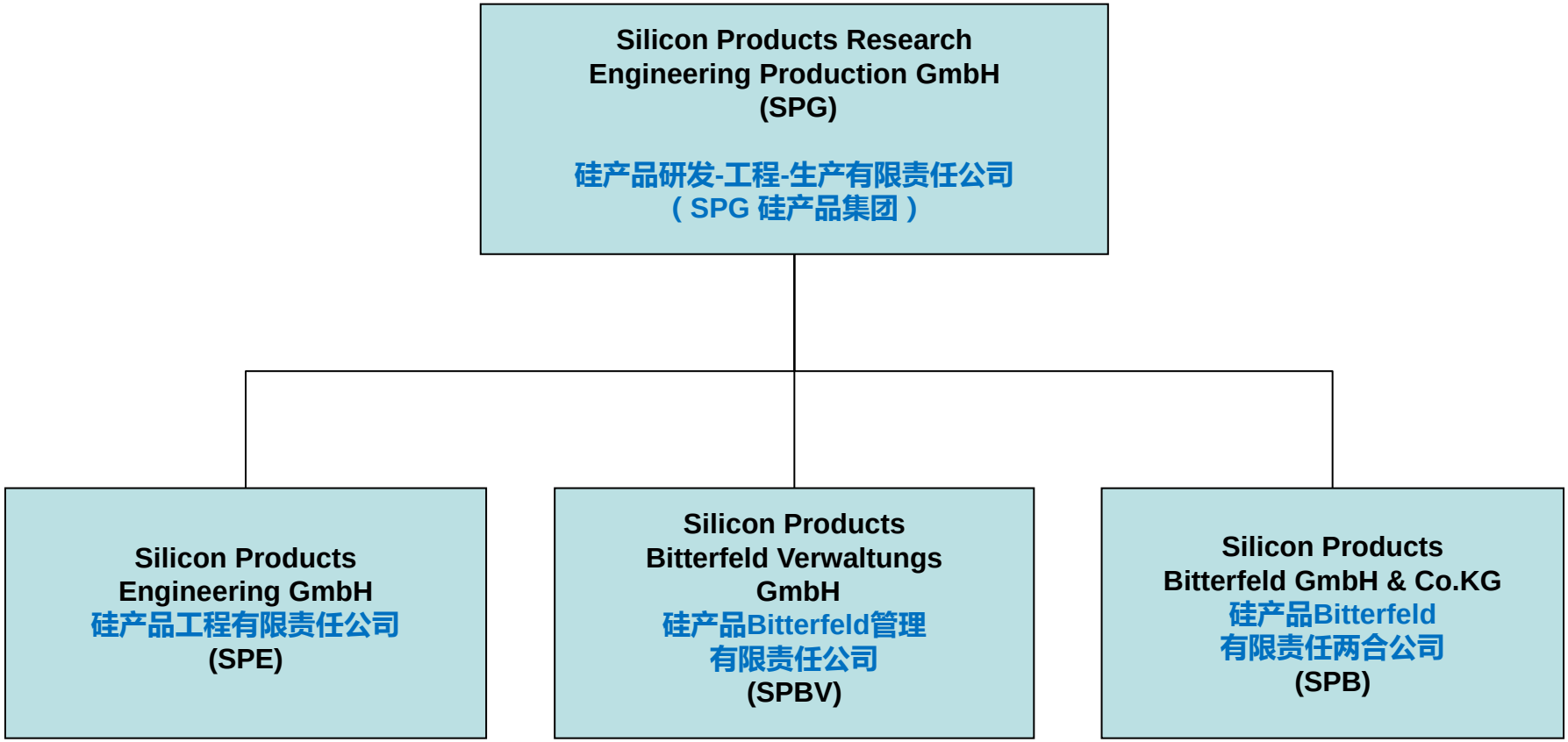
Silicon Products Group

硅产品集团

Dr. Hilmar Tiefel

Dr. Friedrich Schaaff

Company Structure SP-Group
硅产品集团公司构成



Engineering activities 工程业务

- Consulting 咨询
- Basic engineering (Silicon Plants, single Equipment) 基础工程（硅工厂，单台设备）
- Sale of equipment, e.g. Converters, silver-plated Deposition-reactors and Slim rod Production Units and Welding Devices, Boron adsorbers (CPS)
  设备销售，例如氢化炉，银钢复合板还原炉，硅芯炉及焊接设备，除硼系统（CPS）
- Simulations (CVD, Kinetics) of apparatus and machines
  设备/机器模拟（化学气体沉积，动力学）
- HAZOP (Hazard and Operability) Studies 危害性和可操作性分析
- Benchmark tests 基准测试
- Process and equipment optimization 工艺和设备优化
- Production-related services for example maintenance of production lines
  与生产相关的服务，例如生产线维护

Research & Development 研发

- Silicon Production: Processes and Equipment 硅生产：工艺和设备
- Impurity balance 杂质平衡
- Silicon quality / Analytic concepts 硅质量/分析方案
- Latest development: lift-off wafer technology 最新研发：外延剥离硅片技术
- Silicon Recycling 硅回收利用

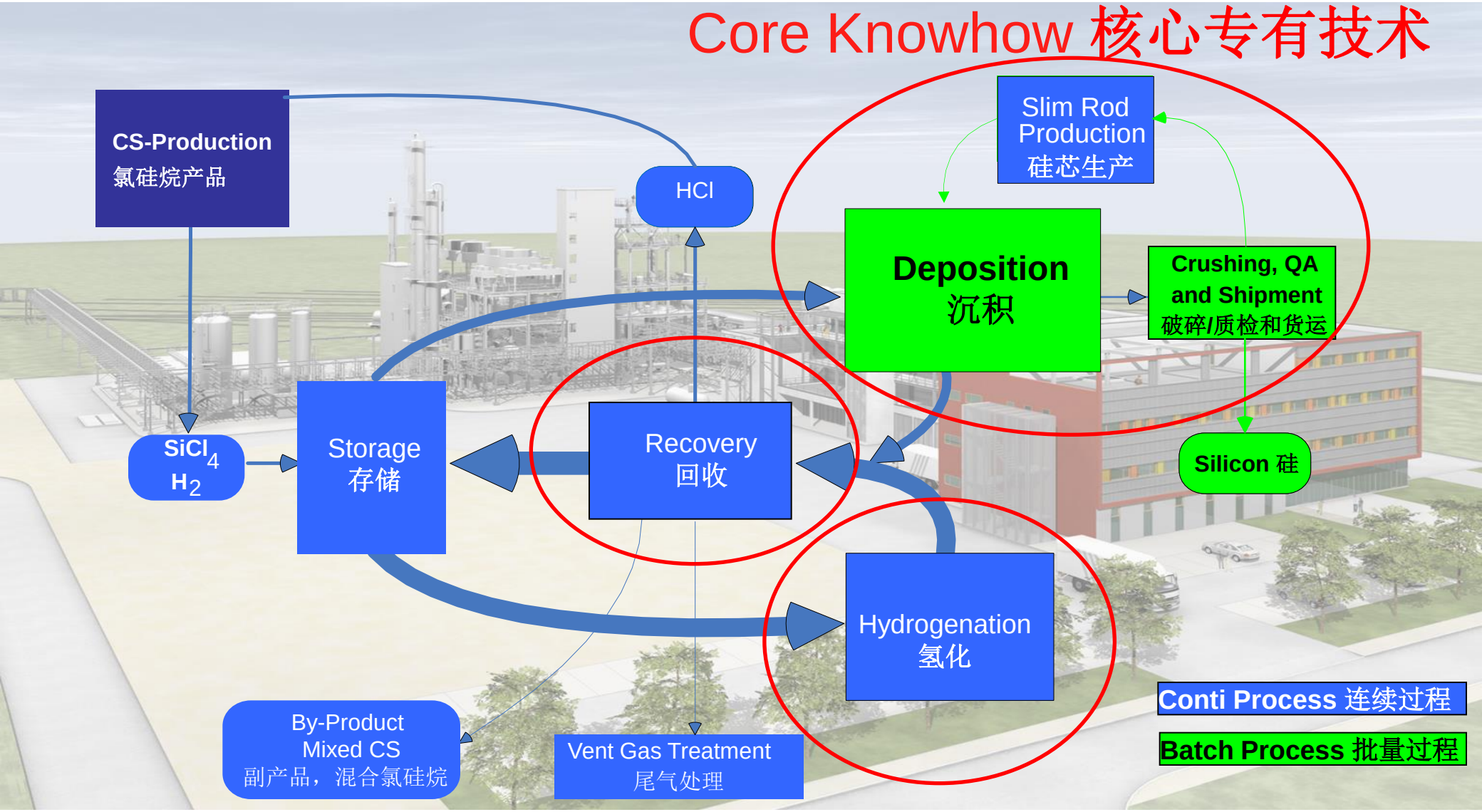
Products 产品

- Solar-Silicon for multicrystalline application 用于多晶硅的太阳能级硅
- Solar-Silicon for monocrystalline application用于单晶硅的太阳能级硅
- Silicon for FZ and semiconductor application用于区熔和半导体的硅
- By-products (Slim rods, TCS, Hexachlorodisilane) 副产品（硅芯，TCS, HCDS）

Business Areas of Silicon Products Bitterfeld
硅产品Bitterfeld经营范围

Simplified Flow Chart of Production Process
生产工艺的简化流程图

silicon products
RESEARCH ENGINEERING PRODUCTION



Silicon Production Plant Bitterfeld
硅生产工厂Bitterfeld

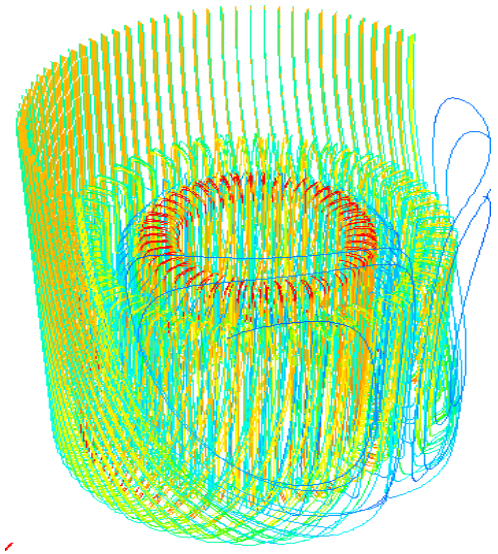
silicon products
RESEARCH ENGINEERING PRODUCTION

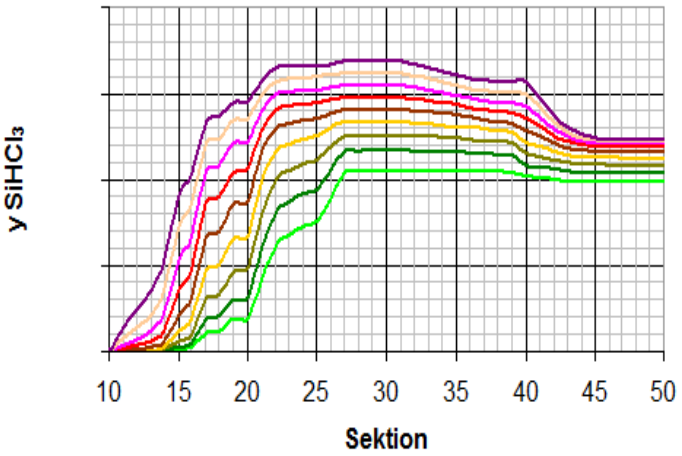
Silicon Plant – Reactor Building
硅工厂 – 还原炉车间

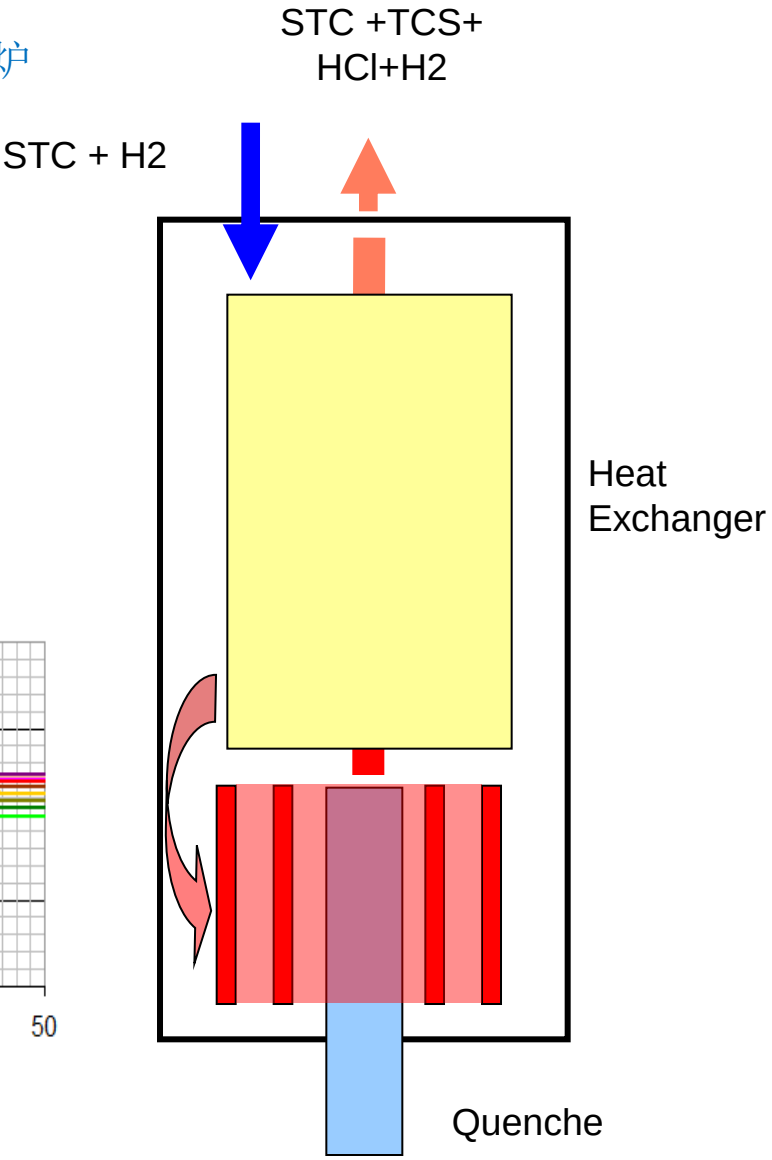
silicon products
RESEARCH ENGINEERING PRODUCTION

Hydrogenation 氢化

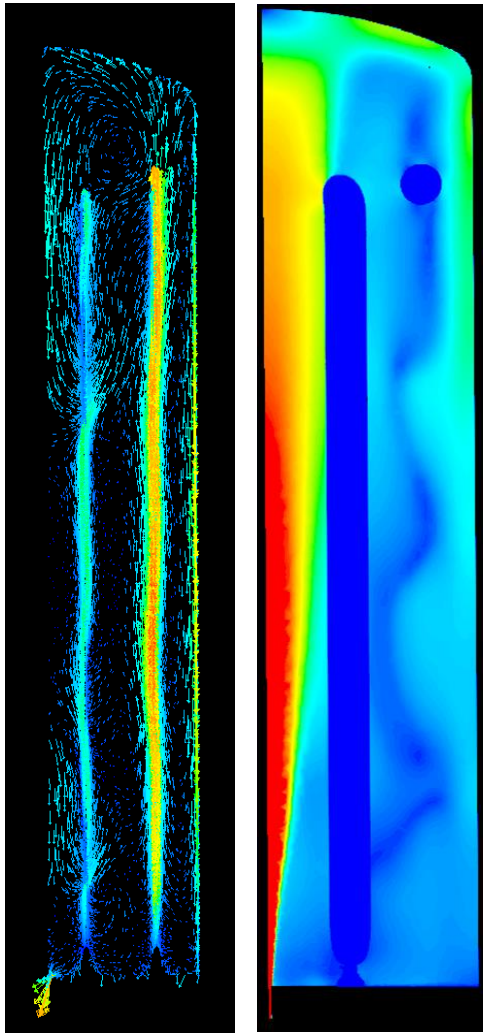
- New own developed hydrogenation reactors自主开发的氢化炉
- High yield 高转化率
- Low power consumption < 0,8 kWh/kg TCS 低电耗
- High throughput up to 15.000 kg/h STC 高处理量
- High energy recuperation 高能源回收







Siemens reactor 西门子还原炉

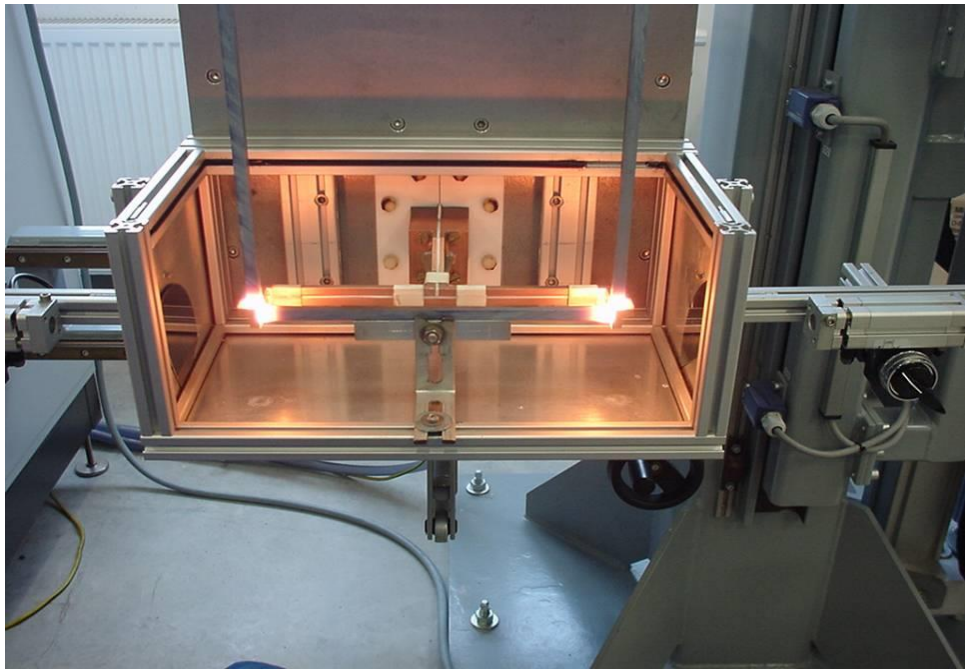


Simulation CFD
计算机流体动态模拟

First Silicon Out
第一炉硅下线

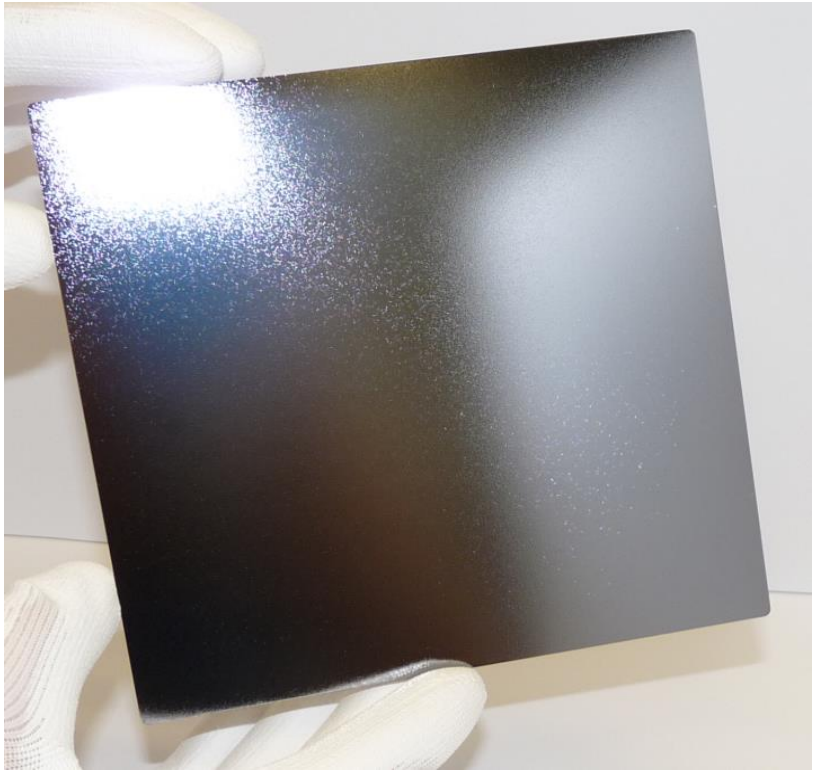
Standard Production
标准化生产

Slim rod production unit
硅芯生产单元



Slim rod welding
硅芯焊接

Slim rod production
硅芯生产

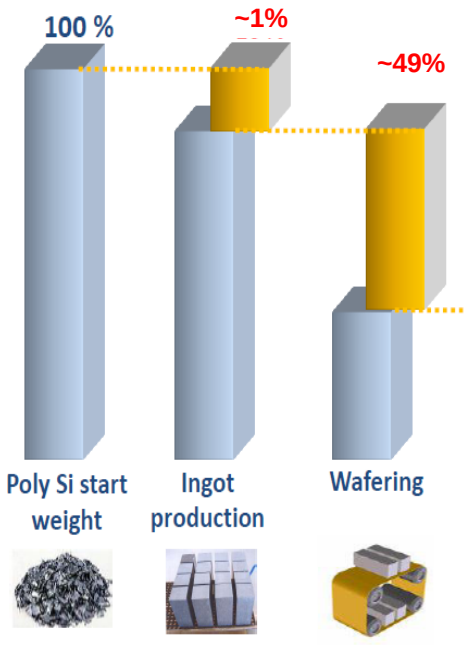


Research and Development

研发

Current Silicon Wafer Technology
现有硅片技术

Standard wafer technology still dominates the solar silicon wafer technology
标准硅片技术仍然占据太阳能硅片技术的主导位置。



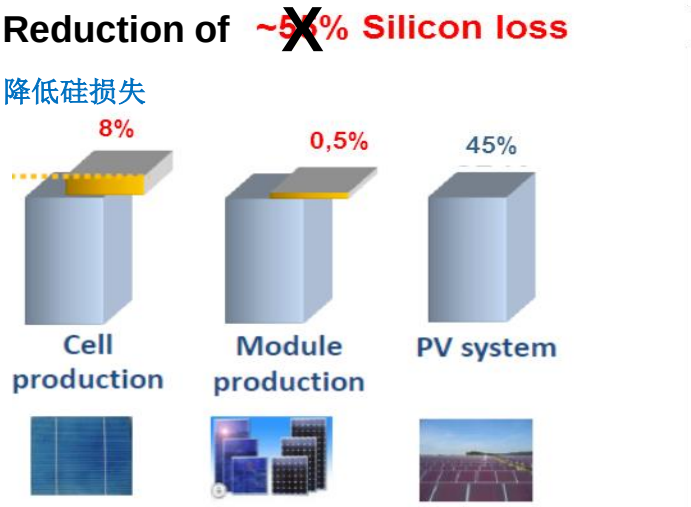
~50% Silicon loss by standard wafer production
标准硅片生产时损失~50% 硅

Silicon production: 硅生产	Siemens CVD 西门子CVD工艺	>90% market share
Mono/Multi silicon crystallization: 单晶/多晶硅拉制	Czochralski/VGF 直拉/垂直梯度凝固法	100 (40/60)% market share
Wafering: 硅片制作	multi-wire sawing 多线切割	100% market share

Motivation: **Production of wafer without silicon losses**
动机： **生产硅片过程中没有硅损失**

Project: Production of wafers via gas to wafer technology
项目： 通过从气体到硅片的技术生产硅片

Gas - to – Wafer/
Epi lift-off Technology
气体 – 硅片/
外延剥离技术



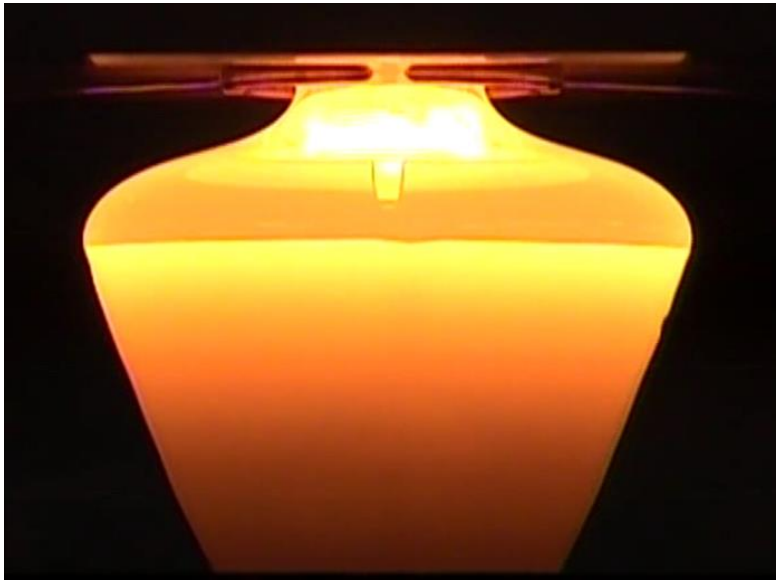
Source: Garbo, PHOTON's 10th Solar Silicon Conference, Berlin 03/2012, revised 2014 by SPB

Float-Zone Silicon for semi-conductor market
用于半导体市场的悬浮区熔硅

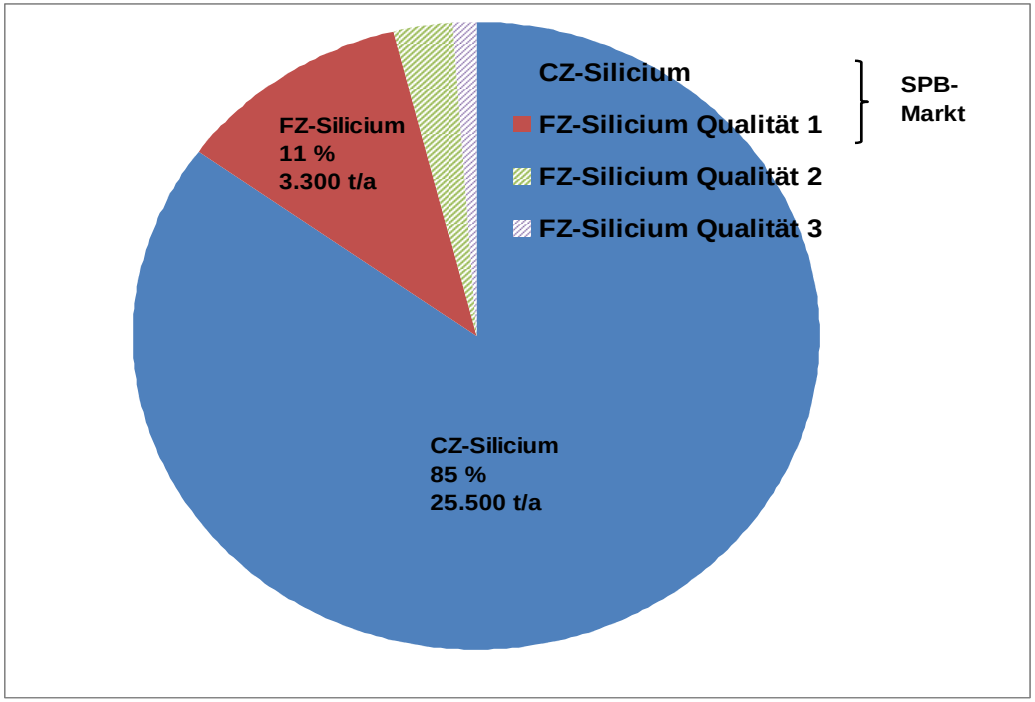
silicon products
RESEARCH ENGINEERING PRODUCTION

Status: Float-Zone (FZ) tests are done by potential customers, further tests ongoing

现况： 悬浮区熔测试已通过潜在客户完成，正在进行进一步的测试



Mono-crystalline FZ-test using SPB Silicon
使用SPB硅进行单晶悬浮区熔测试



Hexachlorodisilane 六氯乙硅烷

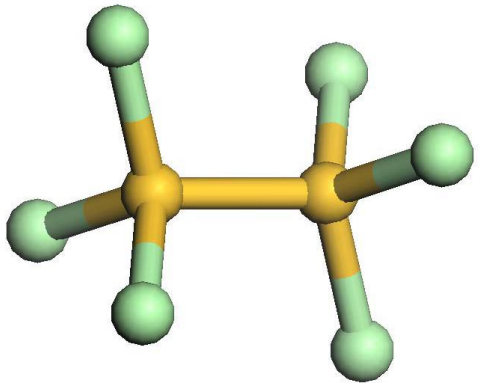
silicon products
RESEARCH ENGINEERING PRODUCTION

Production: 10 t on stock (mixture)
产品： 10吨库存（混合）

Status: Proof of concept, separation and purification
现况： 方案验证（实验室规模），分离和提纯

Economic potential: up to 1000 €/kg Hexachlorodisilane
经济趋势： 可达1000 €/kg

Market: Semi-conductor industry (Application: precursor)
市场： 半导体行业（应用：先驱）



$Cl_3Si\text{-}SiCl_3$ (Si_2Cl_6)

- SPG has long term operational experience producing silicon regarding quality, throughput and cost savings
  SPG在生产硅产品的质量，产量和成本方面具有长期的运行经验
- SPG diversify into new markets for example Cz- and FZ-Silicon and Hexachlorodisilane for semi-conductor industry
  SPG市场多元化，例如用于的半导体行业直拉硅和区熔硅和六氯乙硅烷
- SPG has engineering expertise
  SPG拥有工程专业人才
- SPG possess core know-how
  SPG拥有核心专有技术
- SPG has its own R&D division and works on different research projects for example Epi lift-off wafers
  SPG拥有自己的研发部门，致力于不同的研究项目，例如外延剥离硅片
- SPG developed an optimized process for large scale silicon production plant
  SPG为大规模硅生产工厂开发了优化的工艺

Thank you very much for your attention