



Crystallize Your Visions
in the Photovoltaic and Semiconductor World

Our team and equipment

- Multinational team
- PhD. scientists
- Physicists and material scientists
- Electrical and mechanical engineers
- Application centre equipped with various crystallization methods (CZ, VGF, FZ)
- Metrology systems

Funding and research programmes

- Applied developments
- Close contact with institutes and universities e.g. Fraunhofer Institutes:
 - IISB
 - ISE
 - CSP
 - THM



Crystals for the Next Generation

PVA TePla is the world's market leader for silicon crystallization equipment for the high-tech semiconductor and photovoltaic (PV) industry. All relevant industrial crystal growing systems (CZ, VGF and FZ) for mono- and multi-crystalline silicon and other materials are available at PVA TePla. Our mission is to convince our customers of our technological progress and individual customized solutions resulting from more than 50 years of experience in crystal growing technology.

To ensure that our customers remain competitive, to provide support at an advanced technological level and to meet their high quality demands, here at PVA TePla we insist on providing a high degree of innovation, close cooperation with our partners, reliability and an acute awareness of our own quality.

From planning the factory to the process improvement phase during production, we provide reliable support and outstanding solutions. We know by heart that only our customers' success can be our own success.



- Cooperation and longterm partnership
- Customer support of your fab
- Planning and layout phase
- Realization
- Start and ramp-up mode
- Implementation and improvement
- Continuous production optimization



CCIC:

R&D – Training Centre – Product Management

PVA TePla founded the Competence Centre for Industrial Crystal Growing Systems CCIC in 2008 to be prepared for future technology and application requirements in the PV market. The highly innovative PV industry needs new materials, concepts and approaches, next-generation equipment, new products, a high standard of automation and effective new technology solutions.

In our team, we see continuous system improvement, innovations and the centralisation of crystal growing expertise as forming the focus of the CCIC's activities. A wide range of crystal growing systems and metrology equipment is available for customer demonstrations, process development and new design testing in a cleanroom environment.

The Research and Development (R&D) department is the key innovative CCIC institution. Applied developments, continuous process and equipment optimization and maintaining close contact with scientific institutes and universities are its main responsibilities.

A **Training Centre** was established in order to provide technical instructions for operators, service staff and process engineers. We offer hands-on training in order to provide tuition on how to operate our equipment. The theoretical and scientific knowledge surrounding crystal growing processes is transferred in classroom instructions and seminars. Being focused on market trends, supporting the sales organization with detailed technological information, developing a crystal growing solution network with our partners and launching innovations and next-generation products onto the market are what characterise the **Product Management** as being an essential part of the CCIC organization.

Customer support and training

- Training and complete apprenticeship for your staff
- Education of operators, service and process engineers
- Classroom training
- Basic and advanced lessons
- Tests and certificates
- Hands-on and process training service & maintenance training



CCIC Focusing on: Quality – Productivity –Yield – Energy Saving

In the last few years, the PV industry has been one of the fastest growing markets with substantial system throughput and mass production capability being the main market-driving factors. Today, a clear tendency towards increasing solar cell efficiency by improving the crystal quality can be observed. Process development and adaptation is required in order to achieve competitive results. In addition, the productivity and production yield must be raised continuously while at the same time significantly lowering production costs, e.g. energy costs.

This is where economy meets ecology: In the renewable energy market, PVA TePla feels responsible for optimizing its products in terms of energy consumption and therefore contributing to lower CO2 output levels. A new energy-efficient hot zone design, time-optimized process phases and the ability to recycle the argon process gas up to 80% efficiency are our current projects.

The enhancement of crystal quality goes hand-in-hand with establishing advanced metrology and process control solutions. According to the semiconductor industry insitu, integrated and advanced process control (APC) in conjunction with production management software systems (PMS) using statistical process control (SPC) will also gain in importance in the PV world and help to improve the yield in a crystal manufacturing production line.

Due to the fact that crystallization processes require high purity and stable conditions, it is essential for us to participate in cleanroom concept development and vibration-free machine placement solutions. Improving the yield is again our main target.

As a traditional vacuum company, we are continuously improving our vacuum systems and developing new vacuum concepts in cooperation with our vacuum equipment suppliers. Productivity in crystallization processes can be increased by crystallization speed to a certain extent. In addition to optimizing the growth rate, we provide crystallization systems coupled with recharging devices for feeding the silicon material into the hot crucible without interrupting the heat supply. So-called "multipulling" capabilities enable significant savings to be made in terms of the process time and consumable costs.

Customer support and processes

Customer support with solar crystallization processes, such as:

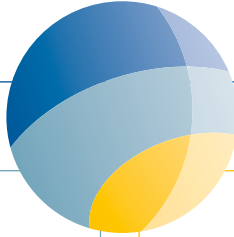
Czochralski (CZ)
Vertical gradient freeze (VGF)
Floatzone (FZ)

- Process development for cost reduction
- Maximizing throughput and efficiency
- R&D for hardware and control software optimization, e.g. feeding technology, magnetic CZ



Vibrations Decoupling Solutions
Advanced HotZone Concepts
Integrated Process Control
Cleanroom Concepts
Argon-Recycling

Production Management System ^{Software}
Metrology to ensure Quality
New System Generation
Vacuum Concepts
Crucible Technology



Cooperation with partners

Si-Cracker
Patents & Research Projekts
Feeder Technology
Service Contracts & Software Solutions

Solution management

Yield Management
Trainings
Innovations
Customer Engineering Specials
Process Development