

# Boron and phosphor dosing for solar panels



Application note A077-EN04-0617C



◆ Solar panels

**Tempress manufactures production equipment for the semiconductor and the solar markets. Both markets rely on semiconducting materials. However, the manufacturing conditions for integrated circuits (computer chips) and solar panels are somewhat different, as the influence of dust particles is less detrimental to solar cells than to chips.**

Tempress is mainly involved in diffusion doping and anti-reflection coating technology. In the diffusion doping step, by means of chemical vapour deposition, silicon is doped with boron and phosphor in order to improve the electrical conductivity properties of silicon. Bronkhorst realised a subsystem to the Tempress diffusion doping machine, generating boron and phosphor containing (oxy)halide precursor vapour flows, making use of a bubbler to convert the liquid precursors into vapour, to supply to the silicon wafers inside the reactor of the Tempress machine.



*Bronkhorst subsystem*

## Application requirements

The main aim is to realise a subsystem to accurately dose boron and phosphor precursors to the silicon wafers. This subsystem needs to be compact in order to reduce the size of the machine, and needs to be 'plug & play' for convenience.

In addition to these 'hard' requirements, a 'soft' requirement is that only one contact point - who speaks Tempress' language - should take responsibility for the entire subsystem development.

### Important topics

- ◆ Accuracy of vapour dosing
- ◆ Compact plug & play subsystem
- ◆ Full responsibility of subsystem development

## Process solution



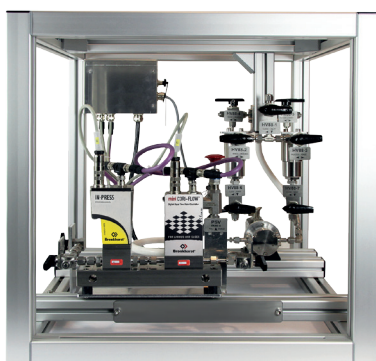
The vapour generating subsystem delivered by Bronkhorst, has the size of an average desktop computer housing. Three of these new compact subsystems occupy the same volume as one conventional vapour/gas dosing system. This subsystem is controlled by the main PLC of the Tempress machine. This main PLC also controls the recipe, i.e. the amount of precursors to be supplied.

The liquid-to-vapour converting bubbler technology is based on Bronkhorst's CEM (Controlled Evaporation and Mixing) technology. Some years ago, Bronkhorst realised an evaporator Solution based on their CEM technology. This CEM supplied water vapour to the reactor, resulting in a higher efficiency of the solar panels. An improvement of the bubbler in comparison to the CEM is the container which is made of glass with a protective polymer coating, and which is chemically resistant to the used precursors. This container is in fact a cartridge that can be exchanged by the user of the Tempress equipment when it's empty. With respect to the approach to realise this Solution, first an alpha unit was developed to demonstrate the proof of principle. This unit was tested at a major Dutch research institute, and the test results served as input for further development leading to beta units, which already resembled 80-90% of the production units ►

And of these production units - fine-tuned beta units - the first orders are now being processed. Bronkhorst took responsibility in delivering the 'plug & play subsystem' fully tested, which means that Tempress could concentrate on their own core business. This Solution has been exclusively developed for Tempress. As Bronkhorst makes customer-specific Solutions, the confidentiality is guaranteed. Only authorized people have access to relevant documentation. As Tempress is a front-runner in the solar market, spending a lot of efforts in R&D, they would like to keep their technological advantage. ■



## Other solution examples



### Flow Control

Optimal space efficient skid for continuous manufacturing process. The skid consist a mini CORI-FLOW mass flow controller combined with a gear pump as the ideal solution to the demanding flow control requirements of the Continuous Manufacturing processes.

- ◆ Customer specific
- ◆ Proven flow measurement technology (mini CORI-FLOW in combination with a pump)
- ◆ Compact assembly ensures space efficiency
- ◆ Combination of functions



### Vapour Generation

'Plug and play' vapour generation skid that consist of CEM-based technology. Liquid flow controllers, mass flow controllers for carrier and dilution gasses and the temperature controlled mixing and evaporation device are integrated. The intended use is generate (saturated) vapour flows.

- ◆ Pre-tested 'Plug & Play'
- ◆ Compact
- ◆ Accurately controlled gas/liquid mixture (mass flow)
- ◆ Very stable vapour flow
- ◆ Flexible selection of gas/liquid ratio
- ◆ Customer specific

## Contact information



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