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## CATE

### IN-LINE COATING PLANT FOR PLASMA-ACTIVATED THERMAL EVAPORATION

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At Fraunhofer FEP, an inline coating plant CATE for (plasma-activated) thermal evaporation is available. Glass plates or metallic plates can be used as a substrate. Moreover, the coating of flexible ultra-thin glass or metallic foils is possible. The substrate size amounts up to  $10 \times 10 \text{ cm}^2$ . Overall, the coating plant CATE consists of six process chambers.

#### Pre-treatment chamber

The pre-treatment chamber can be used to adjust the substrate temperature before the coating. Furthermore, it is possible to implement a plasma pre-treatment by means of a hollow cathode arc discharge. This plasma treatment can contribute to clean the surface of the substrate and to enhance the wetting behavior. The installation of a linear ion source is also possible.

#### Evaporation chambers

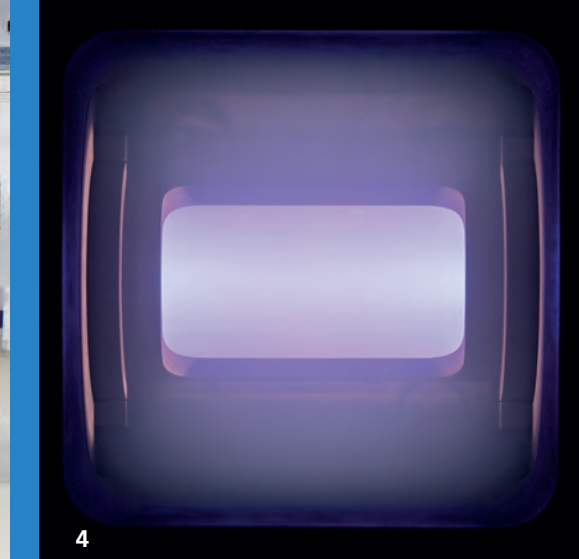
Both evaporation chambers are equipped with radiant heaters to counteract a drop in substrate temperature. The core part of each of those chambers is a heatable graphite crucible on which a heated hole plate is installed to enhance the homogeneity of vaporized particles. It is possible to realize plasma-activated evaporation in the evaporation chamber 1. Thus, the layer growth can be affected and by adding reactive gas ( $\text{O}_2$ ,  $\text{N}_2$ ) to the process oxides or nitrides can be deposited.

#### Sputtering chamber

In this chamber, a DC magnetron sputter source is installed. Both static and dynamic deposition can be realized. A pulsed DC operation mode is also possible. Furthermore, the chamber is used to unload the substrates.

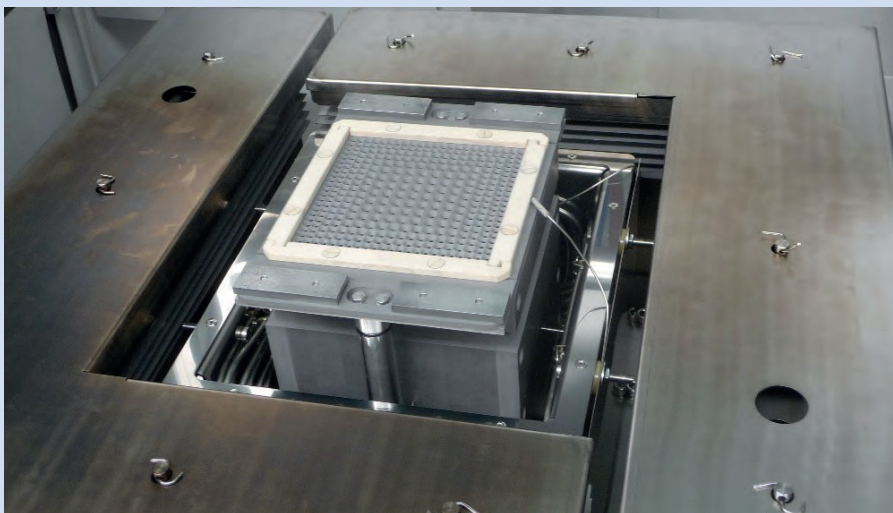


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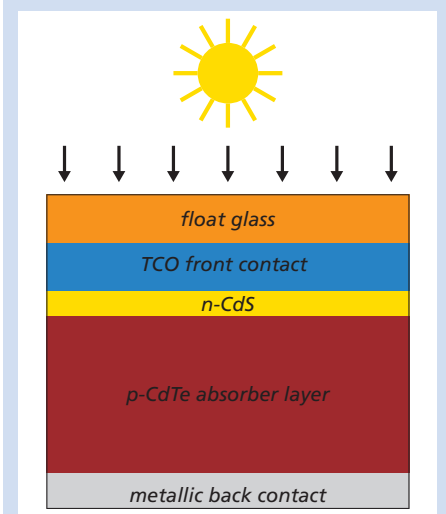


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5 View into one evaporation chamber of the plant CATE



6 Scheme of a CdTe solar cell



## Applications

The inline coating plant CATE can be used for the manufacturing of thin layers and layer stacks with high deposition rate. Between the deposition steps, the substrate does not leave the vacuum environment. Thus, a clean interface is ensured.

CdTe thin-film photovoltaics is one of the important application fields. The coating plant CATE can realize the following process steps:

- Deposition of the semiconductor layers by means of Close-Spaced Sublimation (CSS)
- Window layer cadmium sulfide (CdS) in evaporation chamber 1
- Absorber layer cadmium telluride (CdTe) in evaporation chamber 2
- Chlorine activation of the absorber layer by means of a chlorine-containing gas mixture
- Deposition of the metallic back contact by means of DC sputtering

3 Process chambers of the in-line coating plant CATE

4 In the crucible integrated plasma for the plasma-activated evaporation



We focus on quality and the ISO 9001.

## Our services

- Development and optimization of deposition processes for complex layer stacks
- Physical vapor deposition of new materials
- Plasma treatment of substrates with or without adding reactive gas
- Transfer of existing deposition processes to new types of substrates
- Feasibility studies
- Pilot production

## Funding reference



The in-line coating plant CATE was funded by the European Union and the Free State of Saxony.