

Evaluating the performance of photocatalysts with regard to spectral irradiation using the SoCRatus

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Photochemical or photoelectrochemical processes can be employed for simultaneous treatment of waste water and hydrogen production. Thereby abundant but unsteady solar radiation is used to produce a potent chemical energy carrier. The development and demonstration of suitable reactor devices are addressed in the scope of the German project DuaSol. DLR's test facility SoCRatus (Solar Concentrator with a Rectangular Flat Focus) – see Fig.1 – will be employed in the experimental assessment of developed devices with respect to solar efficiency and stability. First ideas concerning the concentrator were presented in [1]. The SoCRatus specified by a geometric concentration ratio of 20.2 provides homogeneous concentrated solar radiation in the rectangular focus extended to 2500 mm x 100 mm. A representative local standard deviation of irradiation relative to the mean of 2.4% could be determined. [2] The inlet optics of a spectrometer covering wavelengths in the range from 250 nm to 850 nm is directly located in the focal plane. Additionally a pyrheliometer for DNI measurement mounted at the concentrator structure allows the calculation of the total solar input on the photochemical system. As a result the solar-to-hydrogen efficiency can be contrasted with efficiencies respecting specific wavelength ranges. Four identical fluid cycles are available for connection to reactors. The product gas leaving the reactors is analysed by micro gas-phase chromatographs. The UV-part of incoming solar radiation varies significantly during a day. First experimental findings confirm that the productivity of the applied TiO₂ based photocatalysts correlates rather with the UV irradiation than with the DNI.

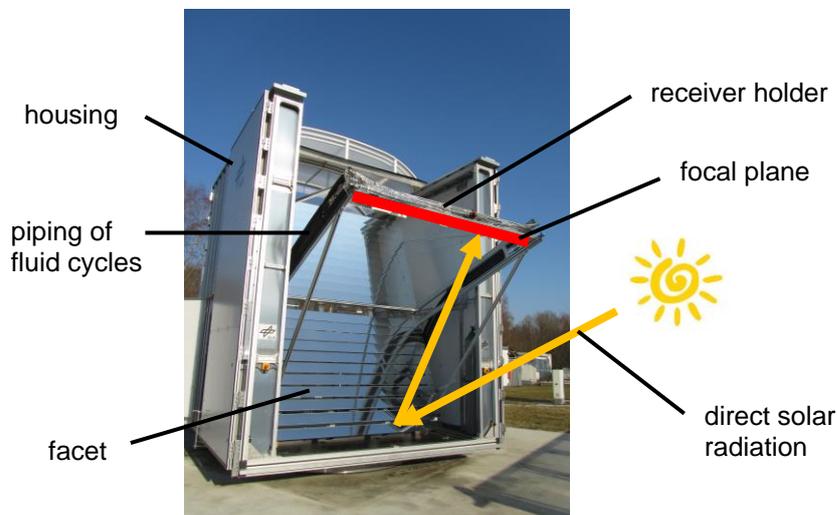


Fig.1 – DLR's 2-axis tracking test facility SoCRatus (Solar Concentrator with a Rectangular Flat Focus) with 22 planar aluminium facets facing solar reactors mounted at the receiver holder

References

- [1] M. Wullenkord, C. Jung, C. Sattler (2012), "Development of a Concentrator with a Rectangular Flat Focus Used for Hydrogen Production via Photocatalytic Water Splitting Employing Solar Radiation", Proceedings of the ASME 2012 6th International Conference on Energy Sustainability & 10th Fuel Cell Science, Engineering and Technology Conference (ESFuelCell2012), 23-26 July, San Diego, USA.
- [2] M. Wullenkord, C. Jung, C. Sattler (2014), "Design of a Concentrator with a Rectangular Flat Focus and Operation with a Suspension Reactor for Experiments in the Field of Photo-catalytic Water Splitting", Proceedings of the ASME 2014 8th International Conference on Energy Sustainability & 12th Fuel Cell Science, Engineering and Technology Conference (ESFuelCell2014), 30 June-2 July, Boston, USA.

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