nano-tera.ch
swiss scientific initiative in health / security / environment systems

SHINE RTD 2013

FNSNF

Self-tracking solar concentration

Enrico Chinello[1], Volker Zagolla[1], Didier Dominé[2], Eric Tremblay[1], Christophe Moser[1]

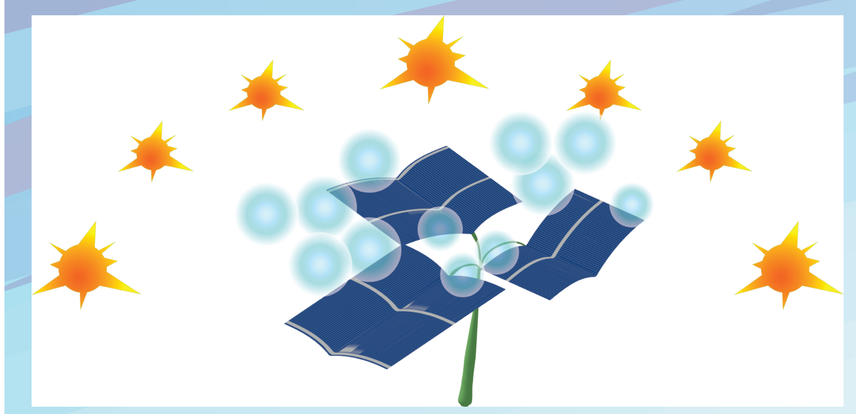
[1]EPFL, [2]CSEM

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

csem

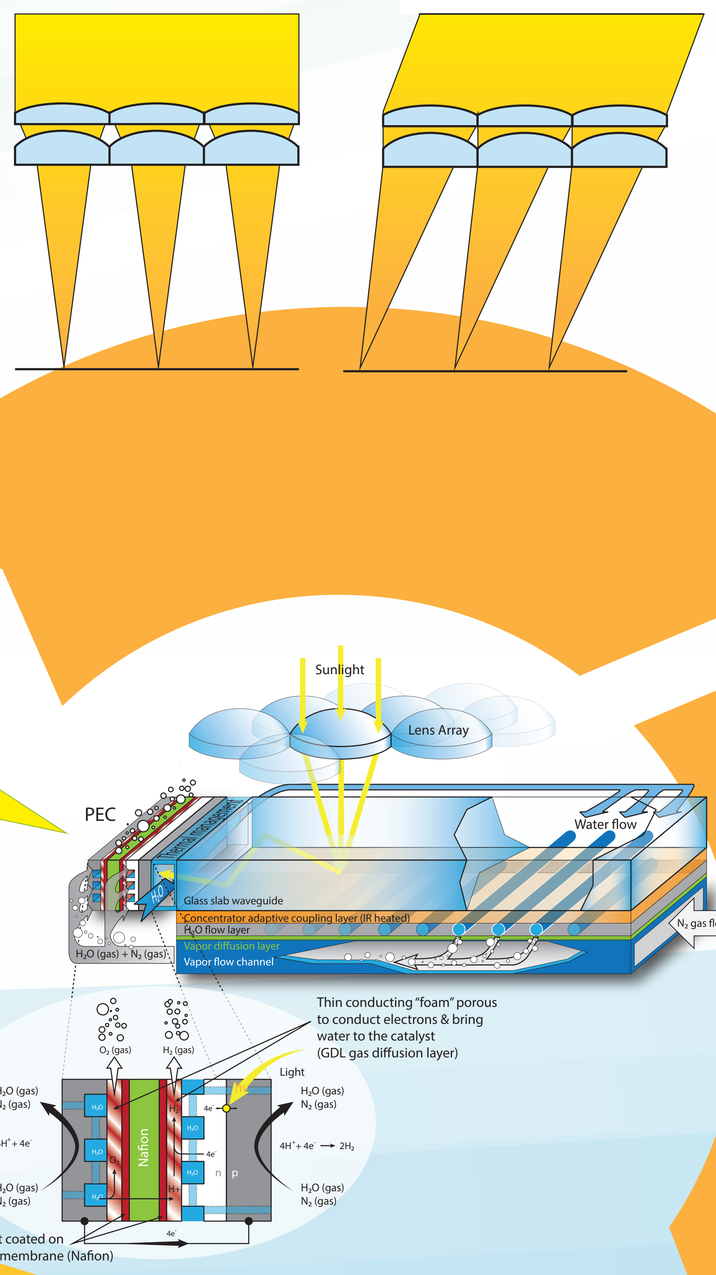
EMPA Materials Science & Technology

MICHELIN

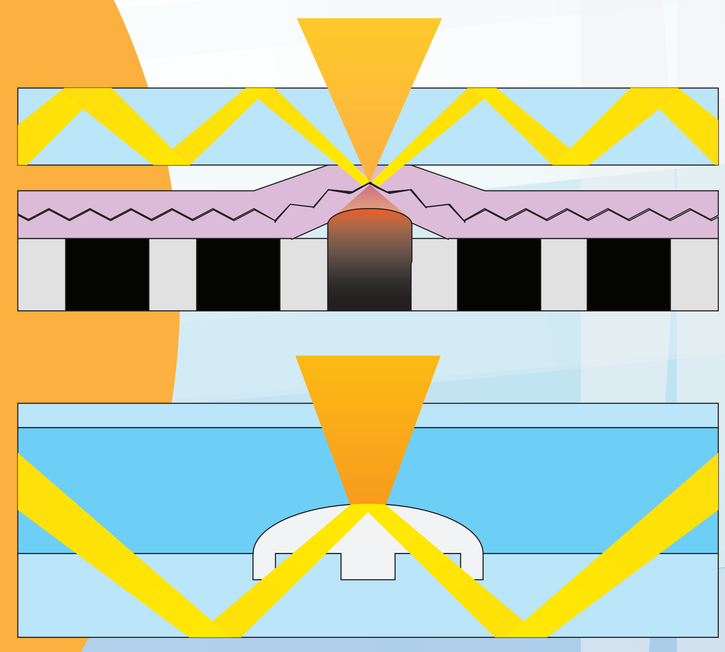


Solar concentrators can play a key role in solar-driven hydrogen generation, resulting in more efficient and cheaper fuel production[1]. Avoiding the power consumption of a mechanical tracker, self-tracking concentrators implement different strategies to capture the sun as it moves, during the day and the seasons. They can increase the benefit in terms of hydrogen cost, system's energy and green-house gases balances[2].

The concentrator's optical system captures sunlight within a certain angular cone and drive it efficiently to the actuator. For a static device, 45° is the recommended minimum acceptance angle.



The concentrator responds to sunlight actuating a coupling element. The principle of using the thermal expansion of a phase-change material has been demonstrated[3].



Alternatively, the exploitation of bubble as coupling element has been validated[4].

Future studies will improve device scaling, to tailor it according to the desired concentration factor (for silicon cells, up to 20x).

Based on a phase-change actuator, a scalable prototype was assembled. The device showed a concentration factor of 3.5x (16° acceptance angle)[5].

[1] Rodriguez et al., *Design and cost considerations for practical solar-hydrogen generators*, En. Env. Science, Issue 12, 2014;
[2] Dumortier et al., *Design guidelines for concentrated photo-electrochemical water splitting devices based on energy and greenhouse gas yield ratios*, En. Env. Science, vol. 8, 2015;
[3] Zagolla et al., *Proof of principle demonstration of a self-tracking concentrator*, Optics Express, vol.22, 2014;
[4] Zagolla et al., *Light induced fluidic waveguide coupling, Optics Express*, vol.20, 2012;
[5] Zagolla et al., *Self-tracking solar concentrator with an acceptance angle of 32°*, Optics Express, vol.22, 2014.