SOLSTICE	Name of the PhD: **Malek MSHEIK** Title of the PhD thesis: **Synthetic fuel production from solar-driven thermo-catalytic decomposition and reforming of natural gas into molten media** Dates (start/end): 11.2020 – 11.2023
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Context and objectives

Solar hybrid processes concern the different thermochemical transformation paths of a hydrocarbon using concentrated solar energy as a high temperature heat source. The considered reactions during the PhD work are thermo-catalytic cracking and reforming of natural gas. The use of molten media such as molten metals or molten salts will be investigated as heat transfer fluids. Cracking reaction produces hydrogen and solid carbon, while reforming produces syngas (H_2/CO) usable for the synthesis of methanol or liquid fuels (via Fischer-Tropsch synthesis). These solar hybrid processes provide the following advantages: (1) fuel saving and chemical storage of solar energy, (2) elimination or reduction of greenhouse gas emissions (CO_2, SO_2, NOx) when compared to conventional processes, (3) non-contamination of products by combustion gases.

Approach

During the first year, a bibliographic study has been carried out in the field of methane pyrolysis. It includes thermal dissociation, catalytic cracking but also emphasizes the recent focus on molten media pyrolysis. Additionally, a new solar reactor (Figure 1) has been built with first experiments in gas-phase before addressing molten media pyrolysis in tin.

Main results

The bibliographic study has led to a publication in Energies [1] while the first results about methane cracking in gas phase were obtained in the temperature range (1000-1400°C) (Figure 1).

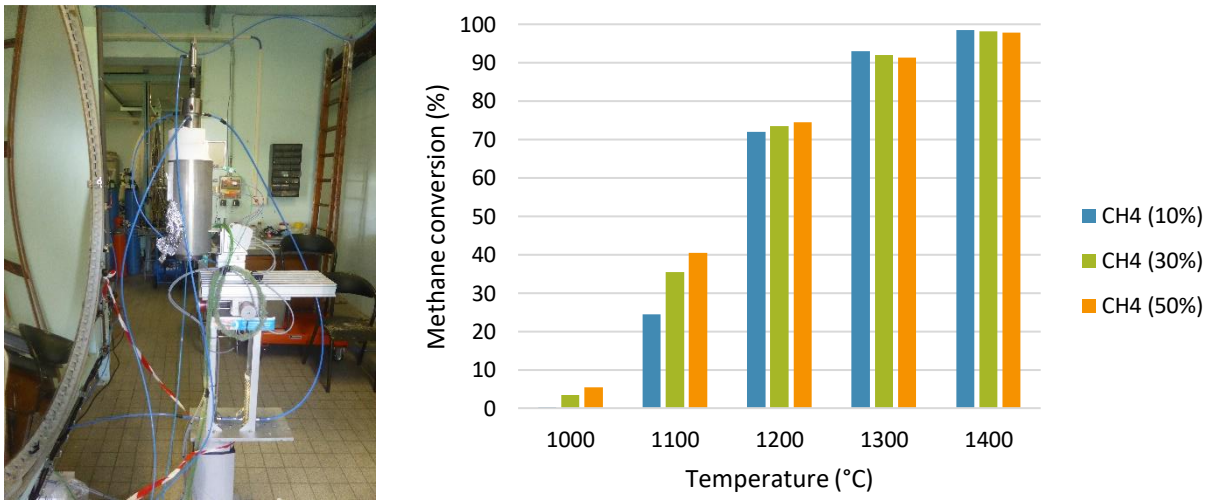

Figure 1: Picture of the solar reactor and associated gas-phase pyrolysis performances vs temperature (Q_{total} = 0.5 NL/min)

Publications in scientific journals and international conferences

[1] Msheik, M., Rodat, S., Abanades, S. (2021). Methane Cracking for Hydrogen Production: A Review of Catalytic and Molten Media Pyrolysis. Energies, 14, 3107.
[2] Msheik, M., Rodat, S., Abanades, S. (2021). A New Hybrid Solar/Electric Reactor for Gas or Liquid Media Methane Pyrolysis, SOLARPACES2021, poster.