

An innovative High Vacuum flat plate solar thermal collector for highly efficient energy conversion

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The high vacuum flat panel is emerging as a reference technology among solar thermal collectors for operation at higher temperatures of up to 200 °C. This device does not use concentration and therefore offers an increased annual energy production owing to both direct and diffuse light capture. Residual gas thermal losses are minimized because the internal pressure is kept well below 1E-4 mbar also under stagnation, when the heat absorber temperature exceeds 300 C. This is possible due to a fully inorganic highly flexible glass-metal seal sitting at the 6-meter panel perimeter and a self-regenerating Non Evaporable Getter (NEG) pump thermally floating inside the high vacuum envelope. Next generation thin film coatings[1,2] are applied to an aluminium substrate to realize a heat absorber with high selectivity (0.95 solar absorptance and 0.1 emittance at 300 C). Multiple copper pipes laser welded to such an absorber allow for parallel flow of heat exchange fluid for maximum thermal exchange up to 16 barg.

References:

- [1] D. De Maio et al., «Multilayers for efficient thermal energy conversion in high vacuum flat solar thermal panels», Thin Solid Films, vol. 735, pag. 138869, ott. 2021, doi: 10.1016/j.tsf.2021.138869.
- [2] D. De Maio et al., « Solar Selective Coatings for Evacuated Flat Plate Collectors: Optimisation and Efficiency Robustness Analysis” Accepted for publication on Solar Energy Materials and Solar Cells (12 April 2022 article number SOLMAT_111749)