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Photovoltaic operation at extreme temperatures

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Abstract:

Hybrid solar electricity generation combines the high efficiency of photovoltaics (PVs) with the dispatchability of solar thermal power plants. Recent thermodynamic analyses have shown that the most efficient strategy constitutes an integrated concentrating PV (CPV)-thermal absorber operating at high solar concentration and at the high temperatures commensurate with efficient commercial steam turbines (~400-600°C).

Regasification of liquefied natural gas (LNG) delivers free cold energy that can be used to prodigiously boost the conversion efficiency of the crystalline silicon (c-Si) photovotoltaic (PV) systems that overwhelmingly dominate the landscape of installed PV power.

These motivations led me to the research on PV operation at extreme temperatures, 80K-750K, and to try answering the following questions.

Are there materials that can withstand high temperatures and still convert sunlight to electricity with acceptable efficiency [1]?

How much can we improve the efficiency of commercial silicon PVs by cooling to cryogenic temperatures [2]?

What is the maximum voltage that can realistically be extracted from a solar cell [3]?

1. Moses, G. *et al.* InGaN/GaN multi-quantum-well solar cells under high solar concentration and elevated temperatures for hybrid solar thermal-photovoltaic power plants. *Prog. Photovolt. Res. Appl.* **28**, 1167–1174 (2020).
2. Gordon, J. M., Moses, G. & Katz, E. A. Boosting silicon photovoltaic efficiency from regasification of liquefied natural gas. *Energy* 118907 (2020).
3. M. Auf der Maur, G. Moses, J. M. Gordon, X. Huang, Y. Zhao and E. A. Katz. Temperature and intensity dependence of the open circuit voltage of InGaN/GaN multi-quantum well solar cells. https://arxiv.org/abs/2104.02114.

Date & Location:

Tuesday, June 8, 2021, 11:00

Zoom seminar