Solar Energy Conversion Using Hot Electron Extraction

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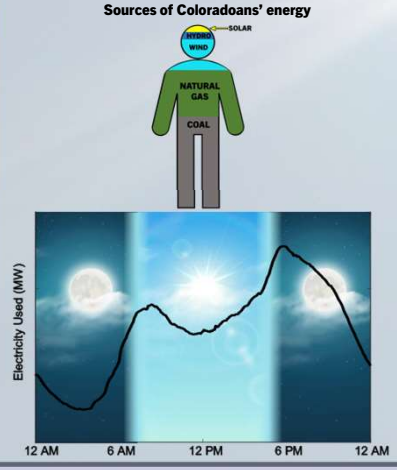
Motivation: make solar energy more efficient and storable



Is solar energy currently competitive with other energies?

NO!

This isn't because of a lack of available energy, it's because we currently aren't very good at capturing solar energy.

We need to improve how we capture solar energy and make solar energy match our energy needs, including

- Change in energy usage throughout the day
- Storing and transporting energy

Objective: make a hot electron extraction device

We know that a specific process called **"hot electron extraction"** is *much* more efficient than what big solar panels can currently do!

- Hot electron efficiency = **66%** of sun energy used
- Regular solar panel = **33%** of sun energy used

PROBLEM: Hot electron extraction is not easy to do because it can't be done with any bulk (large solid) semiconductors.

Can we design a device that does this high-efficiency process AND store solar energy?

What are hot electrons?

Hot electrons are like **freshly boiled water** that will brew tea **strong and fast**

Hot electron device

VS

If that water cools before you use it, your tea will brew **weak and slow**

Standard solar panel

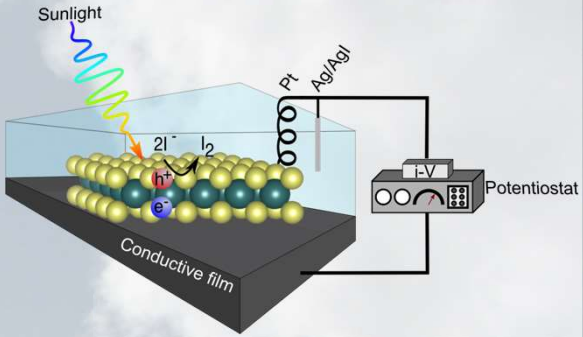
Summary of results

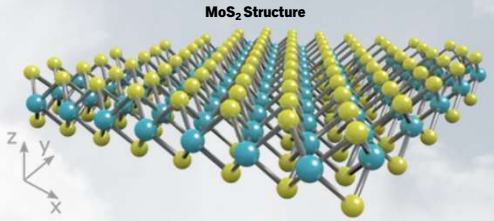
Our collaborative project consists of 3 Principal Investigators and 3 graduate students from CSU and CU Boulder. Our recent results show for the first time:

- **Hot electron extraction used for solar energy conversion**
- **A nanomaterial-based solar energy device that can convert solar energy to chemical fuels**

Solar device design

- Solar absorber = nano-sized MoS_2
- Uses sunlight to do a chemical reaction
- Hot electrons are detected with extremely fast laser pulses





- Nanoscale MoS_2 is a crystal made of molybdenum and sulfur
- It absorbs 10% of incident sunlight with only 3-atom thickness
- Abundant, cheap, non-toxic material

Broader Impacts for Colorado

1

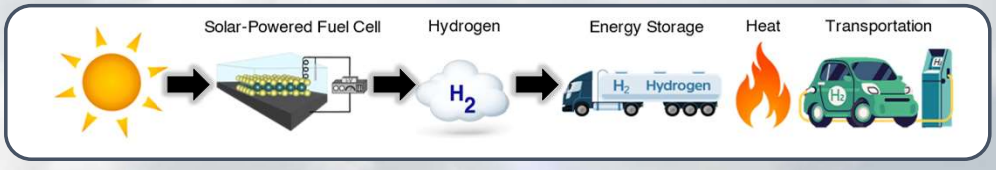
Higher efficiency of the hot electron solar devices will make solar a more viable green energy source.

MORE ENERGY USING LESS MATERIAL

2

These hot electron devices can convert solar to fuels that can be stored and transported

USE SOLAR ENERGY WHERE AND WHEN THE SUN DOESN'T SHINE



Acknowledgements

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