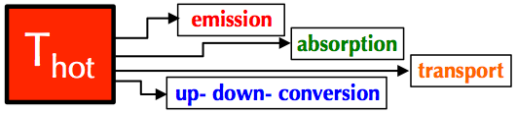
FM Raman Spectroscopy Temperature Sensor

Los Alamos NATIONAL LABORATORY EST. 1943

Build an optical temperature sensor capable of measuring ultrafast transient temperature events with sub-micron resolution

BACKGROUND & MOTIVATION

Characterizing nanoscale transient temperature events is crucial for understanding heat transfer processes.



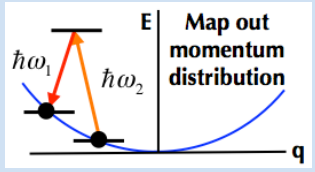
This proposed sensor technology can help understand heat transfer processes for materials and validate nonequilibrium heat transport models to enhance material performance.

INNOVATION

Use FM Raman spectroscopy to characterize the phonon distribution due to the thermal energy deposited by a fast energy impulse

- *This is a novel type of temperature sensor that has never been tested before.*
- ***Fast nonequilibrium temperature sensor***
- ***Room temperature phonon spectroscopy tool***
- ***Precision thermometer (sub-mK resolution)***

- *This study will investigate the capability of this technique to quantify the temporal and spatial distribution of phonons during and after a transient event*

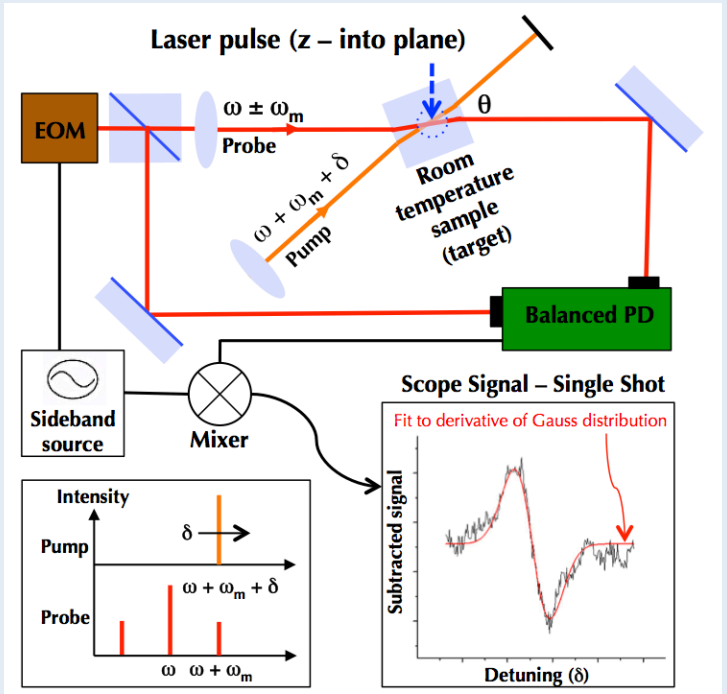


DESCRIPTION

Approach

- *Apply the technique of FM Raman spectroscopy to measure the temperature distribution (100 nK to 10 mK) from a transient event in a single shot (< 1 ms).*

Experimental Set Up



Current Technology Readiness Level (TRL) TRL 1-2

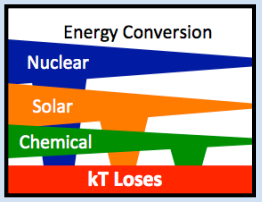
- *There are no known theoretical obstacles*
- *Practical merits far outweigh any risk; it is also very likely others will try similar techniques in the near future*

ANTICIPATED IMPACT

This detector technology will enable or improve understanding of

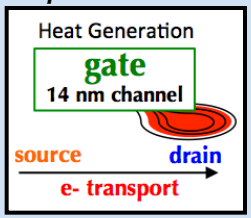
Mitigation and control of (hot) nonequilibrium phonons loses for energy conversion

Optimize material response to transient thermal effects: improve thermal management



Nanoscale thermal transport —

Characterization of heat transfer processes that affect material performance



PATH FORWARD

- ***Procure materials, build detector setup***
- ***Measure phonon spectrum from***
  - ***— ultrafast laser pulse (nJ/50 ps)***
  - ***— incident particle radiation (pJ/50 ps)***
  - ***— circuit element change (μJ/50 ps)***

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