Radiation Hard and High Temperature Tolerant Thermal Imagers

PI: Mina Rais-Zadeh/NASA JPL

Target: Thermal imager in a rover, orbiter, or in-situ probe on hot planets (specifically Venus).

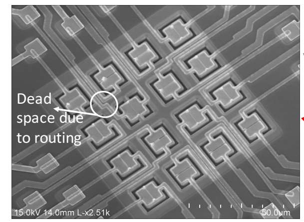
Science:

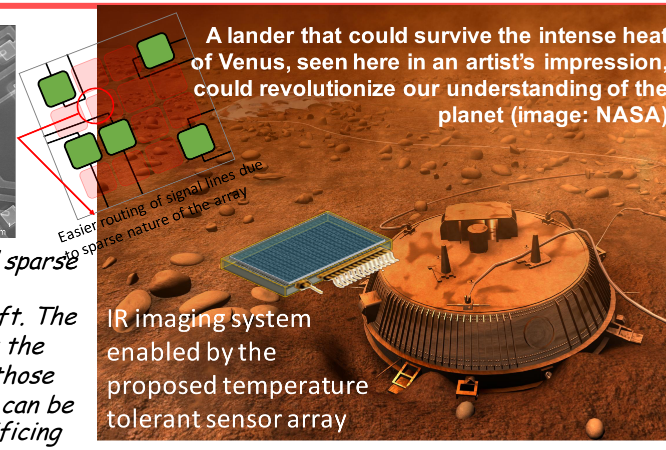
- Infrared imaging at high surface temperatures that is not currently possible, as existing IR imager saturate at such high temperatures.
- Science enabled include 1) understand Venus' early evolution and the evolutionary paths of Earth-sized terrestrial planet; 2) Understand atmospheric dynamics, composition, and climate history on Venus; and 3) Understand how physical/chemical processes interact to shape the modern surface of Venus

Objectives:

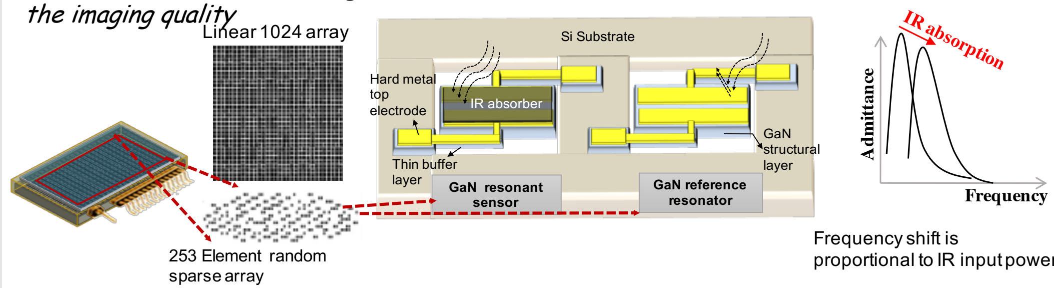
- To develop an instrument capable of taking IR images at 500°C using a <u>sparse array</u> of <u>resonant micromechanical devices</u> in a gallium nitride (GaN) platform with the following attributes:
  - Noise equivalent delta temperature (NEDT) of 50 mK (a 70x improvement in SNR compared to thermopiles if operated at 500°C)
  - Wavelength range: Near to far IR but specifically is capable of imaging at ~4 μm (*i.e.* the peak thermal radiation wavelength of Venus
  - Acceleration survivability of >20,000 g.

CoI: Prof. Debbie Senesky, Stanford University
Prof. D. Dyar, Planetary Science Institute





Top right: An envisioned sparse array equivalent to the fabricated one on the left. The green squares represent the pixels and red ones are those that are omitted. Signal can be routed out without sacrificing the imaging quality



A schematic view showing the thermal imager architecture: incoming IR radiation is absorbed and iconverted to heat, changing the frequency of resonance.

Key Milestones:

- Year1: Linear 5x5 thermal imager array demonstration with NEDT of 100 mK in InAlN/GaN to prove the imaging feasibility at 500°C
- Year 2: Sparse imaging array of 100 elements with NEDT of 100 mK to prove imaging capability of the sparse array
- Year 3: Full sparse array demonstration, each element having NEDT of 50 mK and Q of 2000 in area less than 900 μm^2

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