Temasek Defence Systems Institute

IMPLEMENTATION OF AN OPTICAL READOUT SYSTEM FOR HIGH SENSITIVITY TERAHERTZ MICROELECTROMECHANICAL SENSOR ARRAY

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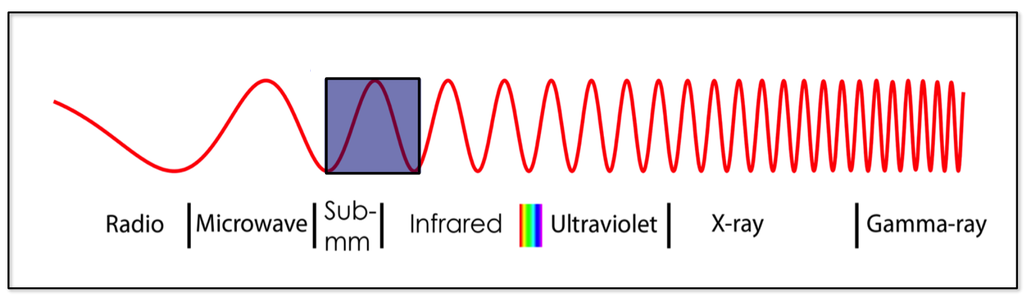
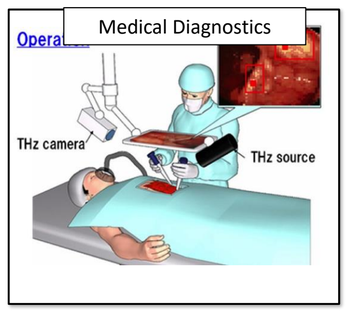
Motivation

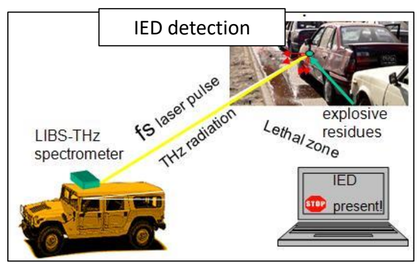


- Higher resolution compared to microwave
- Able to penetrate non-metallic and non-polar materials
- Non-ionizing

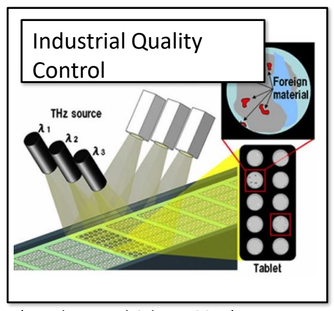
Potential Applications

(Digital Barriers, ThruVision TS4, 2012)



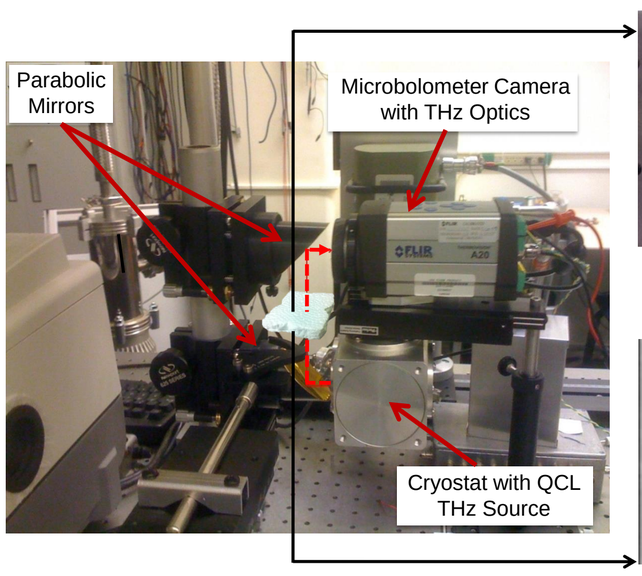


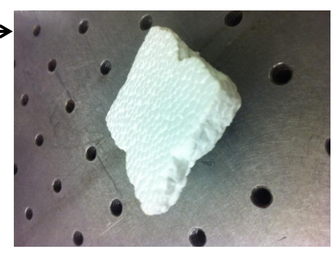
(GlobalSpec Electronics, 2010)



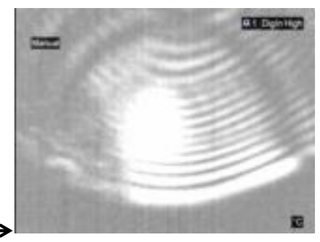
(Hosako, I. and Oda, N, 2011)

Background

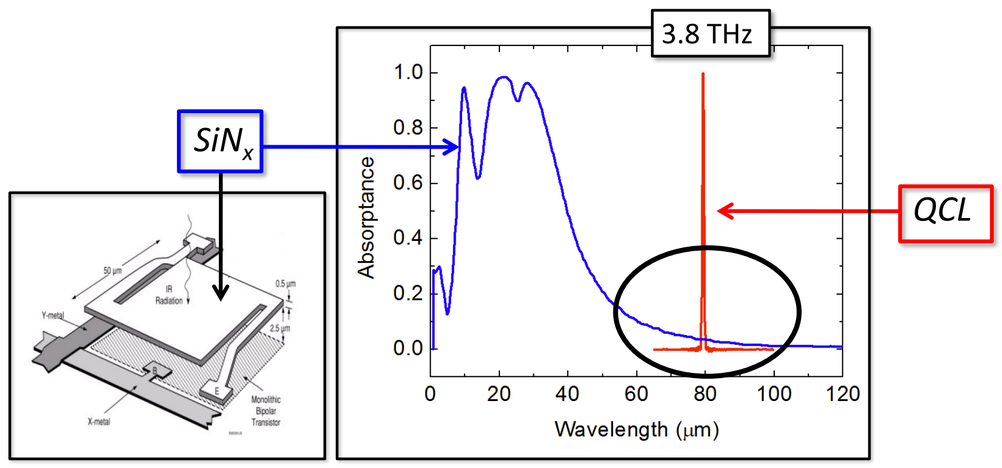




Utility blade hidden inside Styrofoam



B. N. Behnken, G. Karunasiri, D. R. Chamberlin, P. R. Robrish, and J. Faist, "Real-time imaging using a 2.8 THz quantum cascade laser and uncooled infrared microbolometer camera," *Opt. Lett.*, vol. 33, pp. 440–442, Mar 2008.

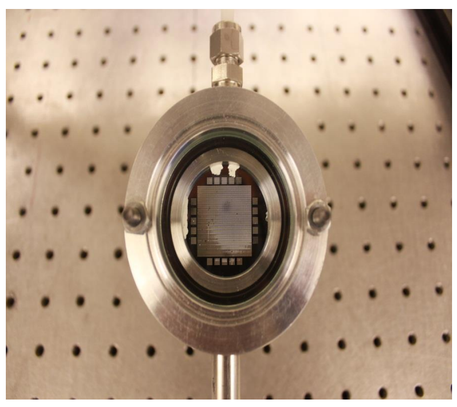


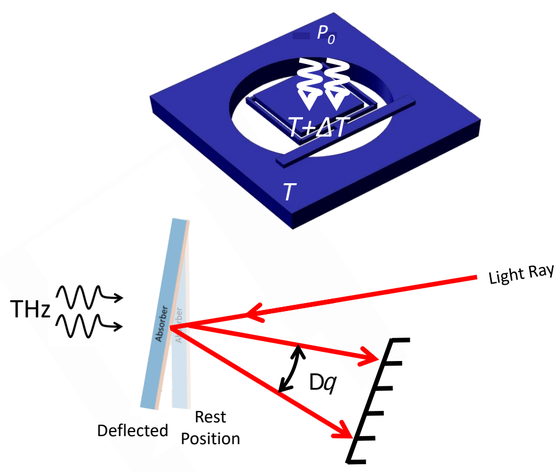
Kurashina, S. and Oda, N., "Bolometer type Terahertz wave detector." U.S. Patent No. 8,618,483. 31 Dec. 2013.(2008).
Alves, F., Kearney, B., Grbovic, D., Lavrik, N. V. and Karunasiri, G., "Strong terahertz absorption using SiO_2/Al based metamaterial structures," App. Phys. Lett. 100(11), 111104 (2012).

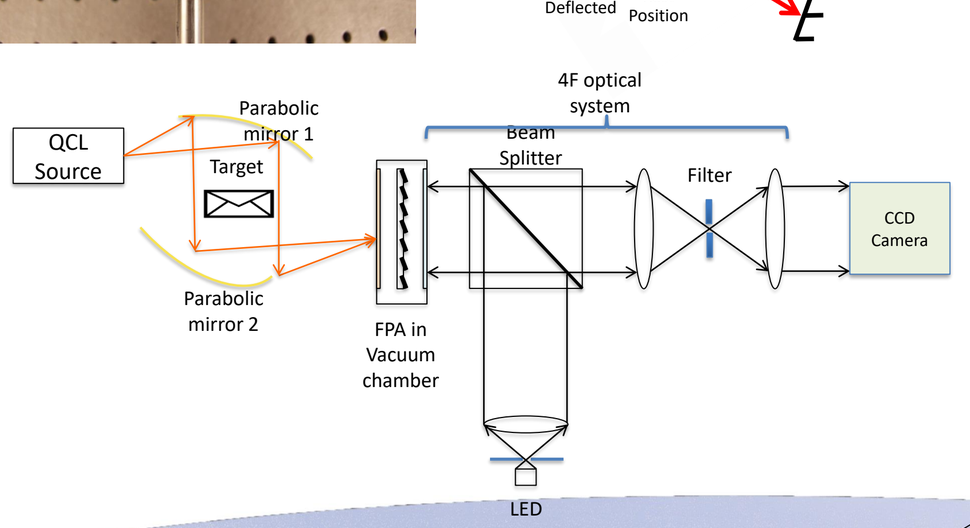
Aim of Thesis

To develop an optical readout scheme utilizing the MEMS based THz sensor to perform imaging under THz illumination.

Replace with IR microbolometer with THz absorbing MEMS FPA

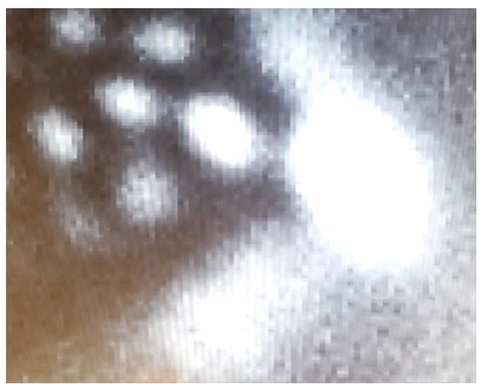




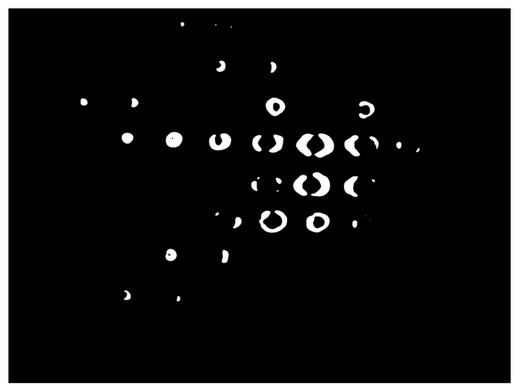


Results

Image of QCL beam



Microbolometer image (pitch size = ~50 μm)



MEMS THz FPA image (pitch size = ~400 μm)

Conclusion

- Developed optical readout scheme based on Fourier 4F optical system for THz imaging
- Concept of optical readout to generate image was validated using a bi-material FPA
- Characteristics of image output due to 4F readout system were explored

NUS National University of Singapore