Text

Our research is motivated by the need for efficient and economical high-frequency (millimeter wave and terahertz) components, devices, sensors, and systems. The underlining theme is the use of electromagnetics theory coupled with micro/nanofabrication to design and demonstrate high frequency circuits and sub-systems at the wafer level.

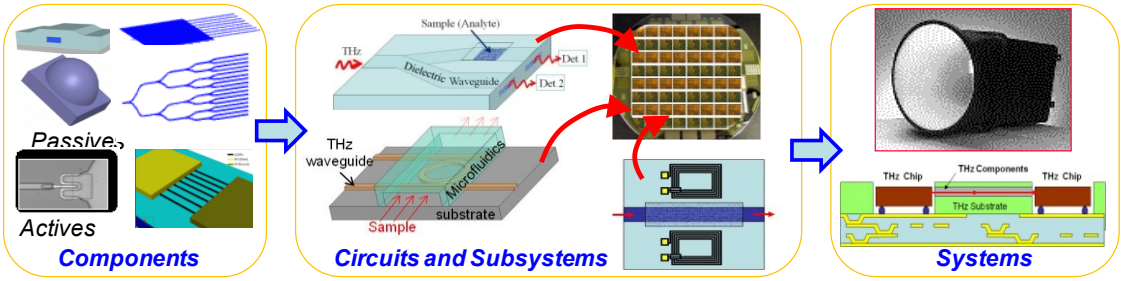

Figure 1. Projects in TeSLa range from device level to systems level.

Current projects range in focus from the device level to the systems level. Some of the ongoing projects are as follows:

1. **THz integrated Devices and Circuits:** Realization of terahertz integrated circuits (TICs) is a major challenge. For THz circuits, the device should have cut-off frequencies well beyond 1 THz. Towards this endeavor; TeSLa is developing nanodevices and circuits through the use of nanowires and graphene materials. Example THz devices and circuits are shown in Figure 2. Under a DARPA funded project, the group is developing THz integrated circuits for THz imagers (THz focal plane arrays). Some of the activities carried out by TeSLa within this area include:
   - Carbon Nano-tube (CNT), III-V nanowires and graphene based devices with ultra-high cut-off frequencies (> 1 THz);
   - Heterogeneous integration of different semiconductor devices on Si;
   - Development of low-cost high sensitivity THz detector arrays (Focal Plane Arrays);
   - THz plasmonic devices and circuits;
   - High frequency broad-band modeling and characterization of devices and circuits.

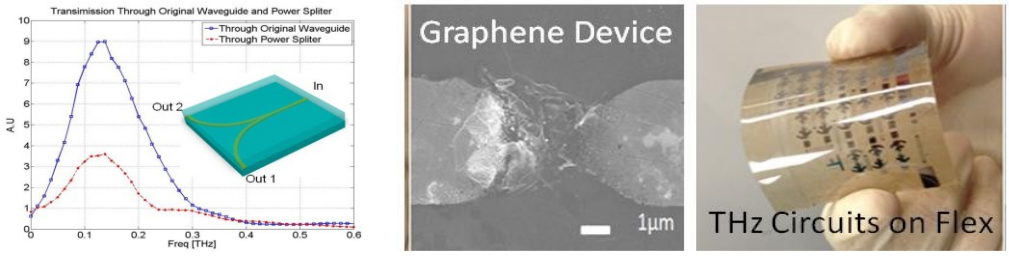

Figure 2. Fabricated THz integrated devices and circuits.

2. **THz Non-destructive Evaluation (NDE) and THz Material Characterization:** With recent advances in light weight plastic and composite structures a vast number of mechanical structures (e.g., automobiles and wind-mills), THz is finding a niche application in NDE of such structures. This area revolves around the development of techniques in order to examine structures and specimens without putting their integrity at jeopardy using THz radiation. Some of the activities include:

- Developing material characterization techniques of non-conducting substrates;
- Developing methods for 3-D objects spectroscopy;
- Imaging for defect or hidden object detection;
- Inspection of specimens for moisture content;
- Developing signal processing algorithms for feature extraction from THz time-domain signals;
- Carrying out sensing studies for chemical and biological applications.

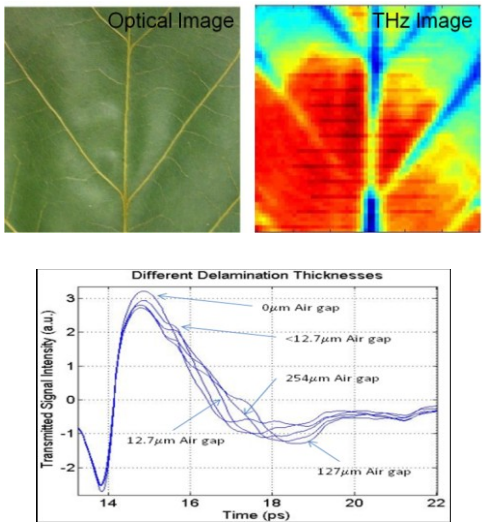

Figure 3. NDE and materials characterization in the THz spectral range. Top: optical and THz image of a leaf; moisture content can be measured using THz. Bottom: Film delamination (e.g., paint) measurement using time-domain THz.

3. **Microwave and Millimeter Wave Circuits and Sensors:** Apart from THz circuits and systems, the group is also active in research in the areas of microwave and millimeter circuits and sensors. One of the major focus areas has been in the development of planar active metamaterial circuits and highly sensitive metamaterial inspired sensors. Some of the projects include:
   - Microstrip metamaterial phase shifters and tunable antennas (X-band);
   - Matamaterial microfluidic sensors;
   - Near field probes for NDE;
   - Wireless power transfer and energy harvesting circuits;
   - Ka-band Leaky wave antennas for fixed frequency beam scanning.

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Recent publications:
http://scholar.google.com/citations?hl=en&user=o6JASRcAAAAJ&view_op=list_works

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