Multi-modality Photoacoustic/Ultrasonic Micro-Imaging: from Scientific Research to Product Development

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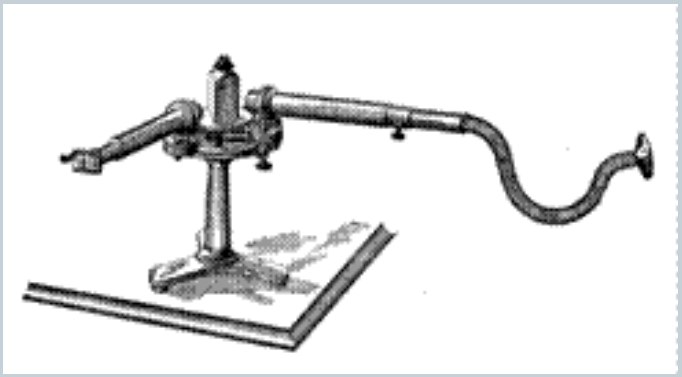
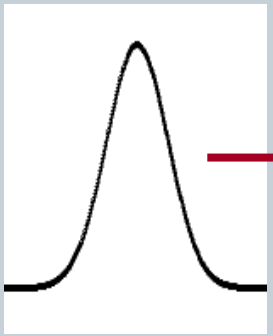
“Photophone”: Scientific Discovery

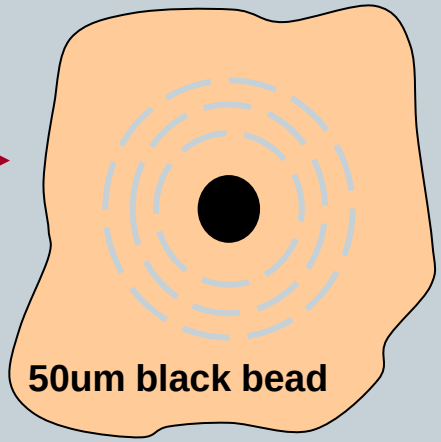


“Photophone”,
Alexander Graham Bell, 1881

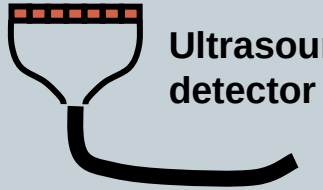
Light can be used to generate sound!

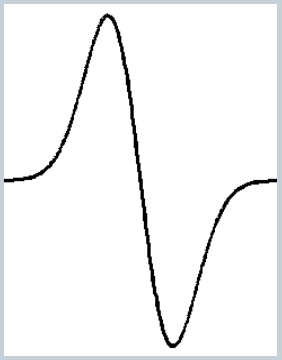
“Photoacoustics”: Biomedical Applications

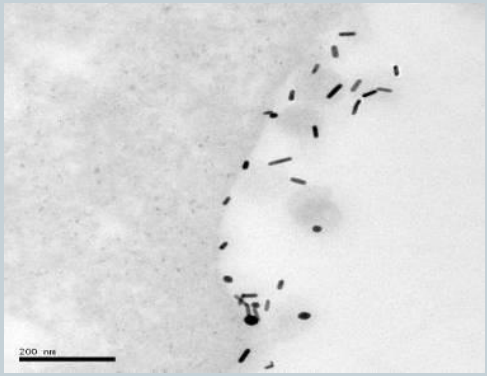


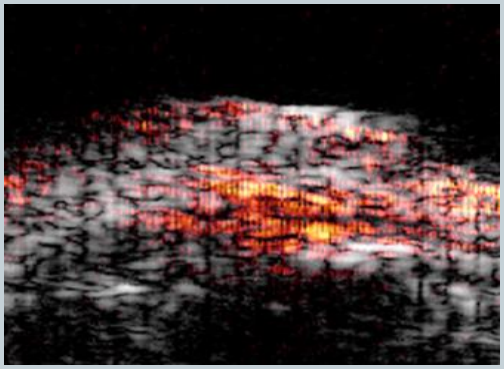


Pulsed Laser





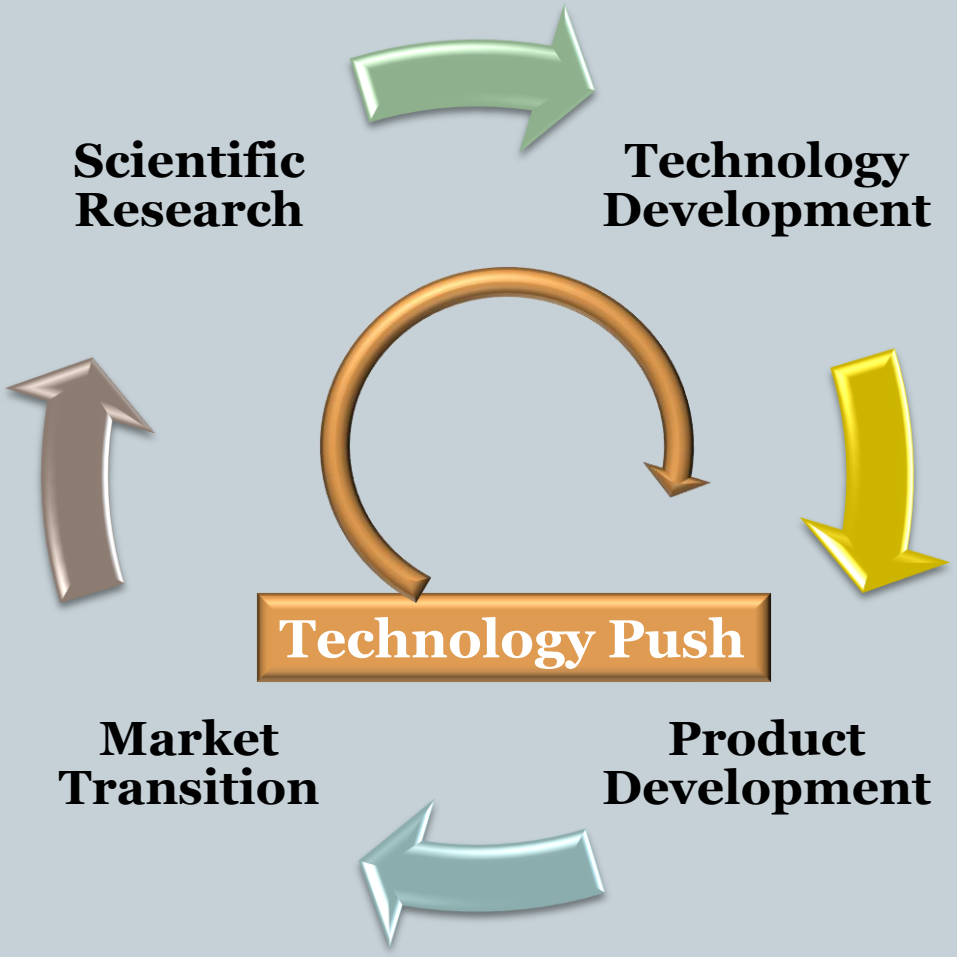




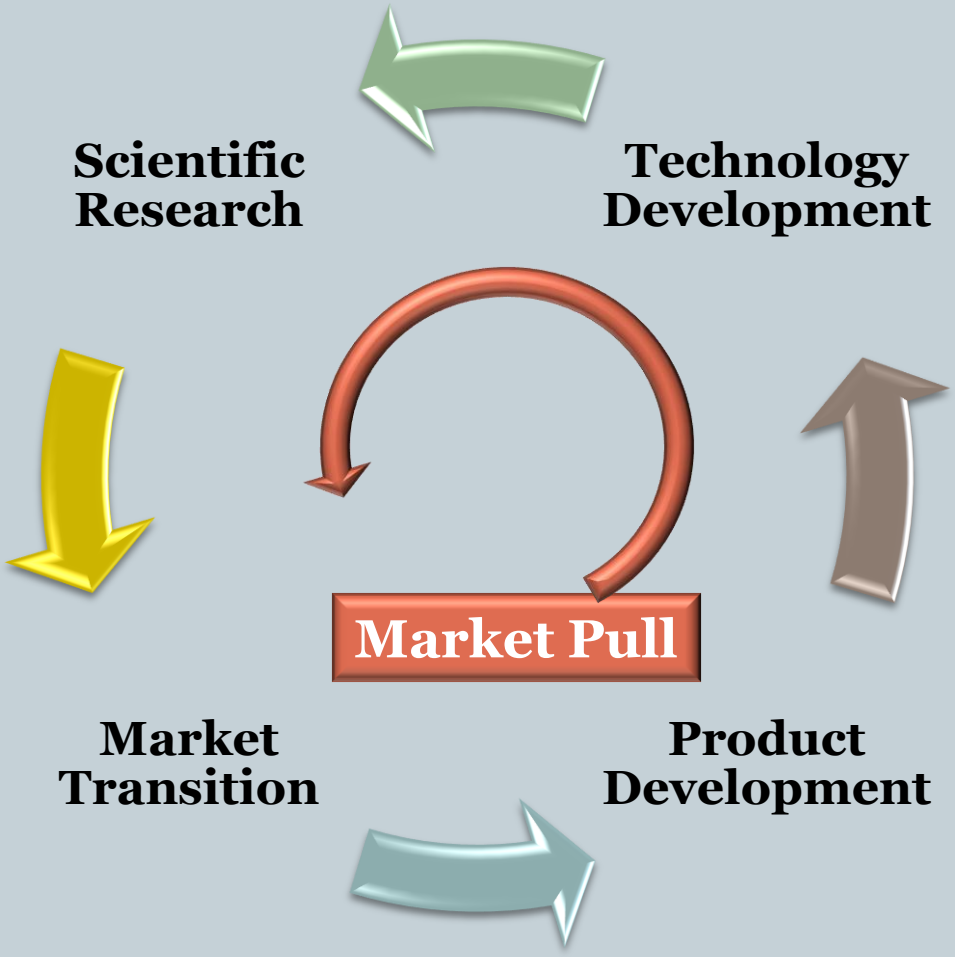
Molecular Imaging and Therapy

*S. Emelianov, **P.-C. Li** and M. O’DDonnell, **Physics Today**, pp. 34-39, May 2009.*

Scientific Discovery → Biomedical Applications



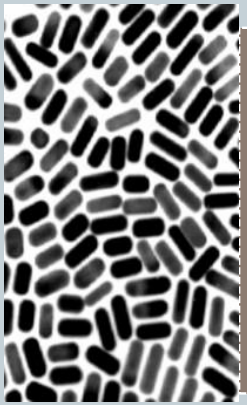
Scientific Discovery ← Biomedical Applications



Technology Push

Pulsed laser for stress/thermal confinement

Ultrasound array technologies



Gold nanoparticles

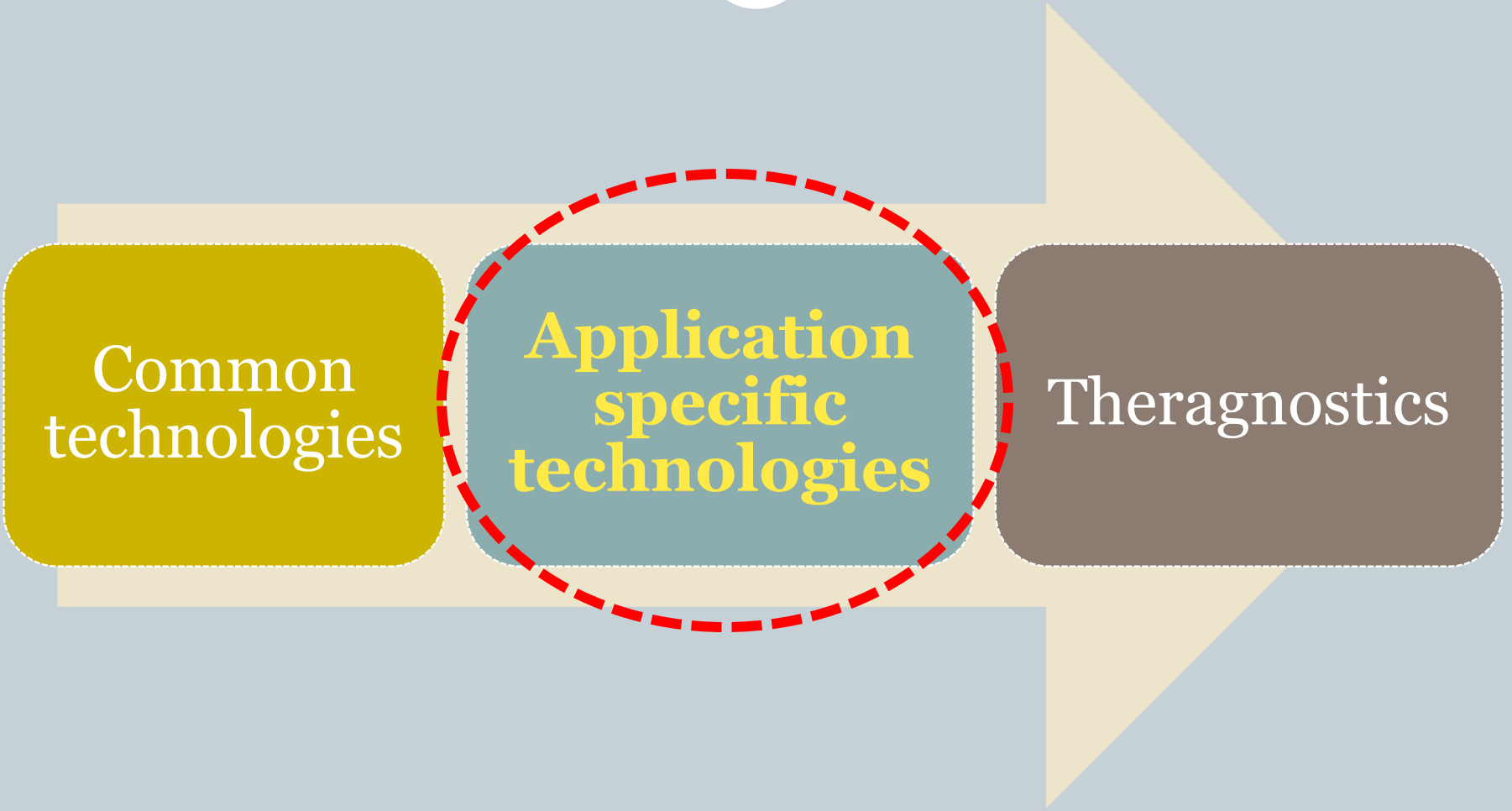
Powerful computers

NVIDIA

PCI EXPRESS

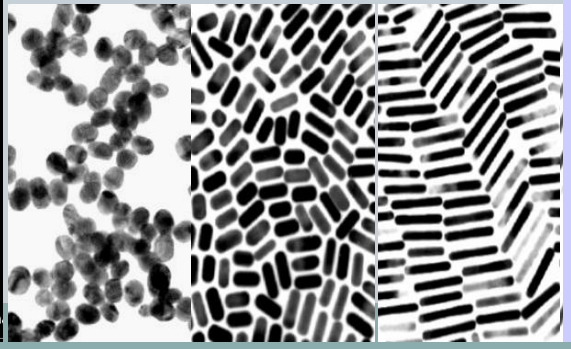
www.acuson.com and Nvidia

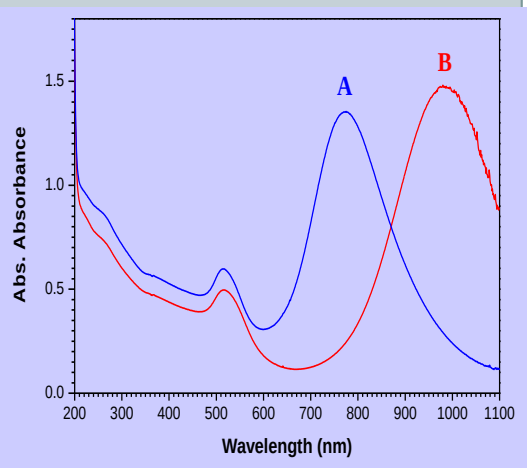
Foresight Taiwan-Phase 1



Market Pull: Better Imaging Tools

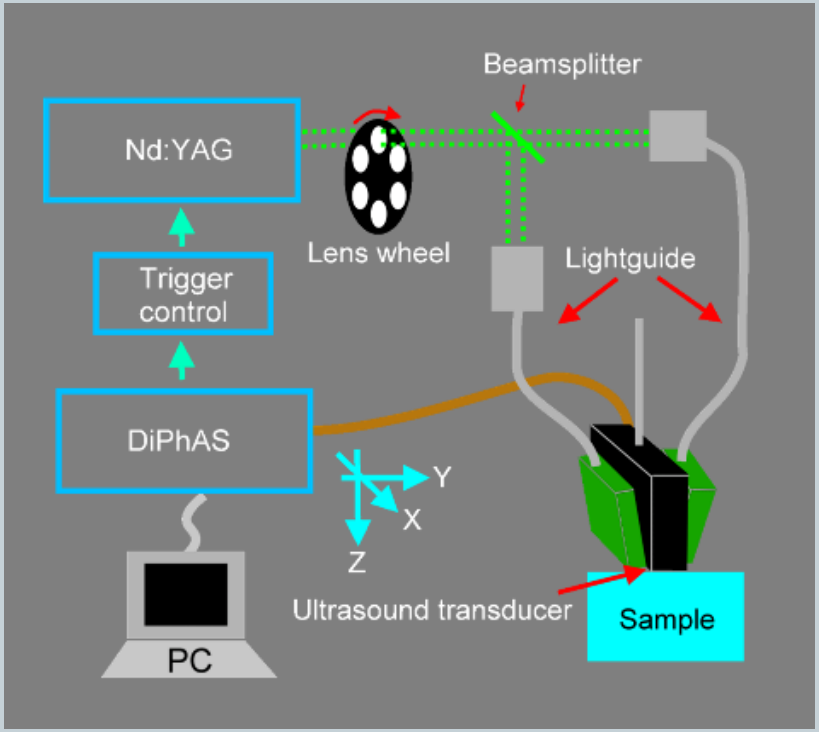
- Molecular imaging:
  - Imaging of molecular process
  - Early detection of disease
- Molecular imaging with multiple targets
  - For better diagnosis

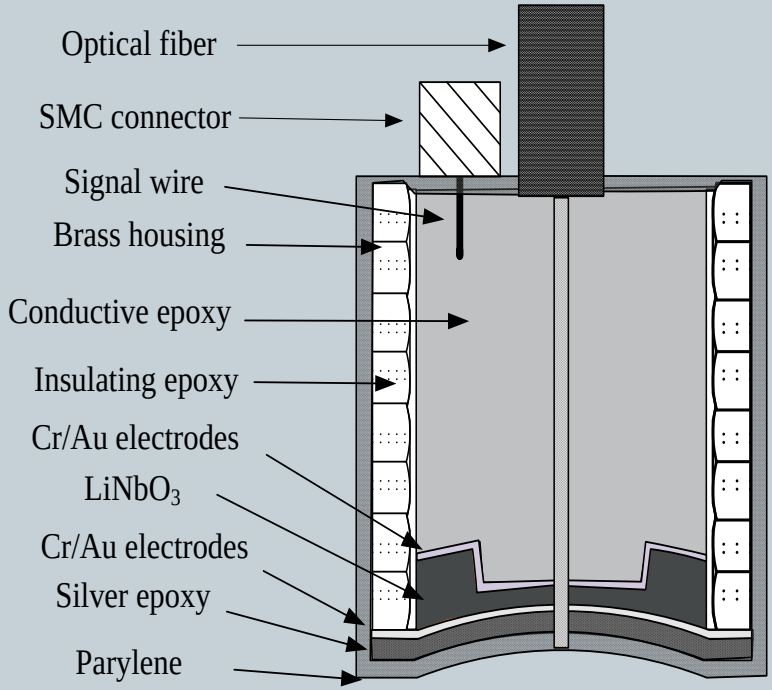




Market Pull: Multimodality Imaging

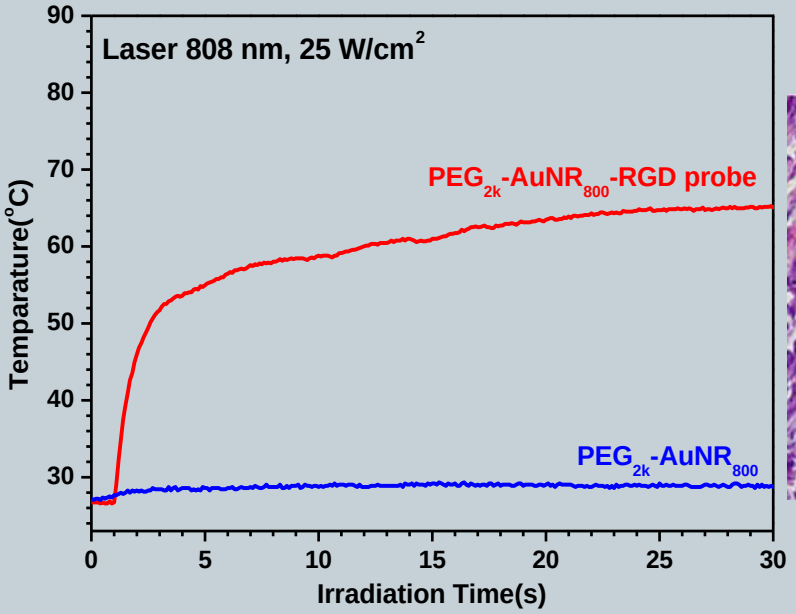
- Combine different imaging modalities.
  - Acquiring complementary information simultaneously.
  - Example: PET+CT, US+PA.

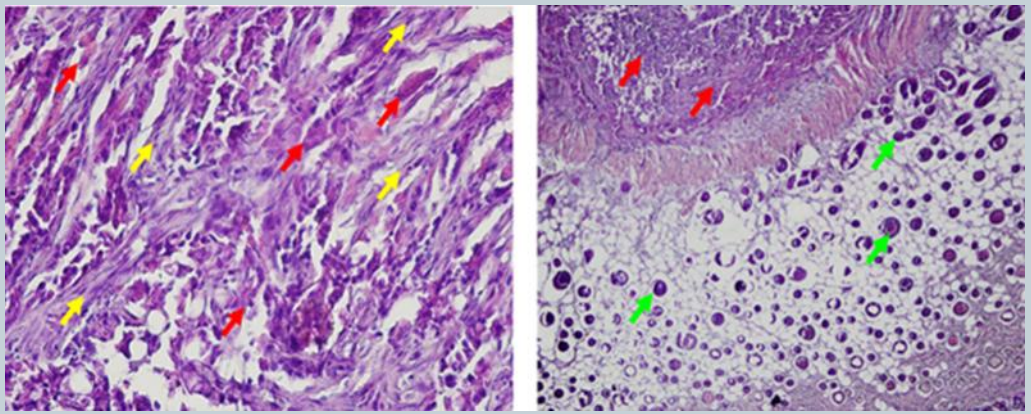




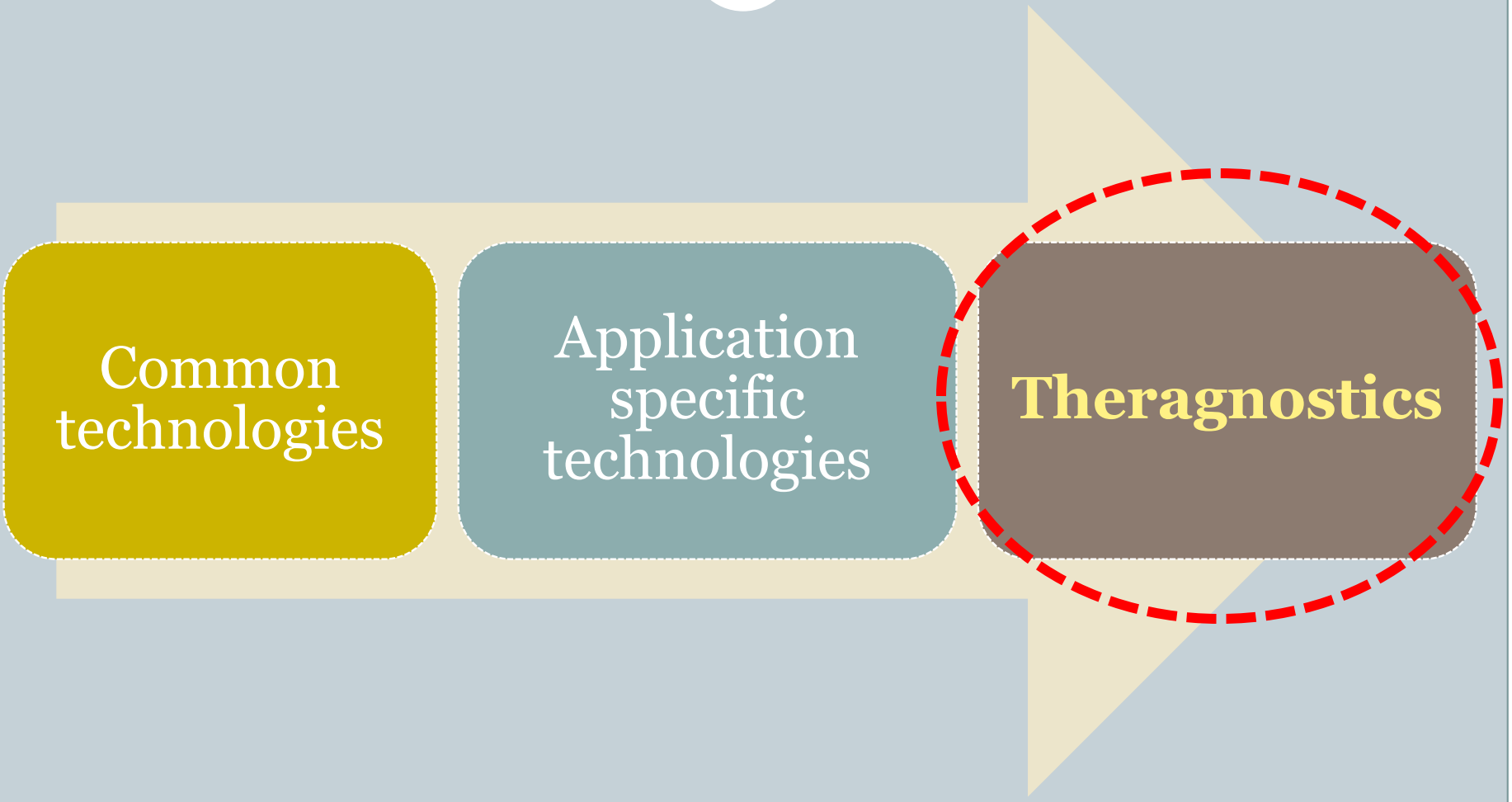
Market Pull: Targeted Therapy

- Targeted photothermal therapy was achieved simultaneously by irradiating nanorods attached to the surface of cancer cells.



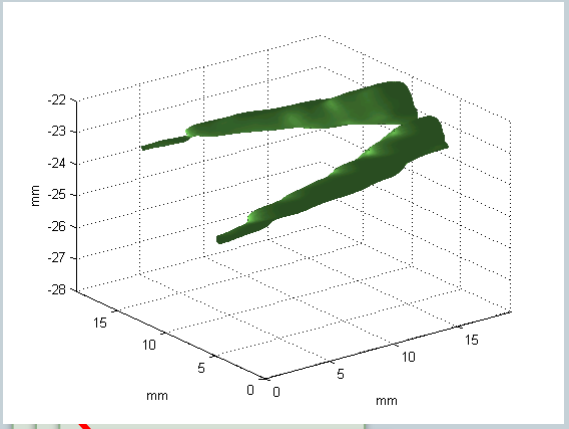


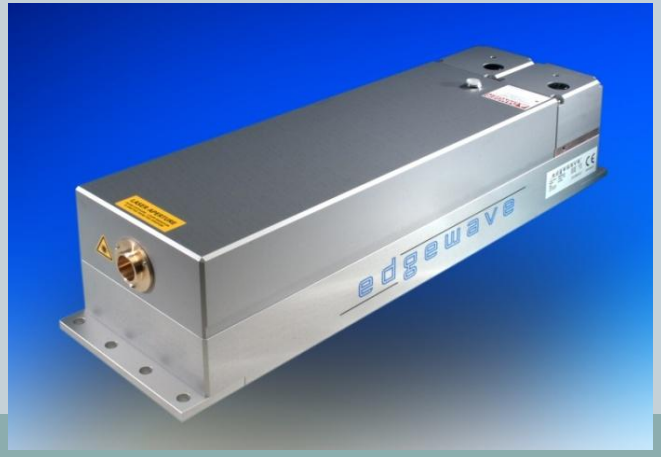
Foresight Taiwan-Phase 2

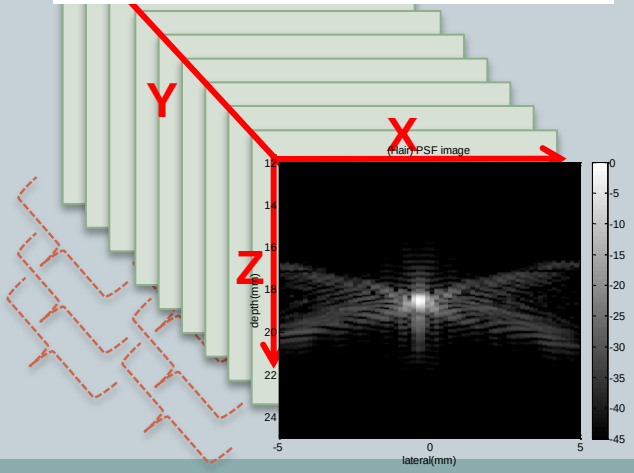


Product Development Innovations

- Real-time 3D photoacoustic imaging

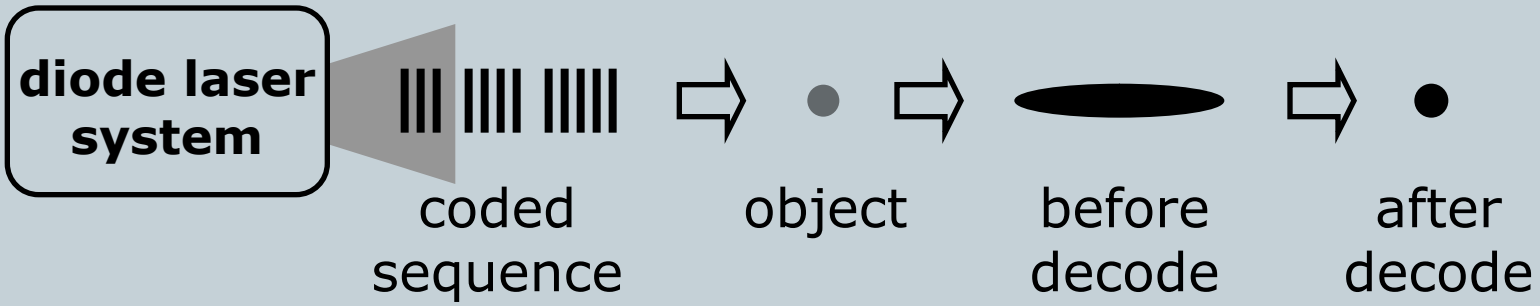


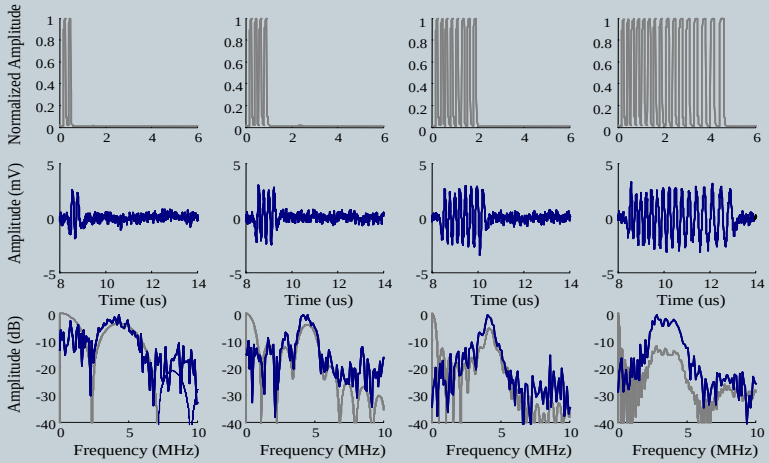


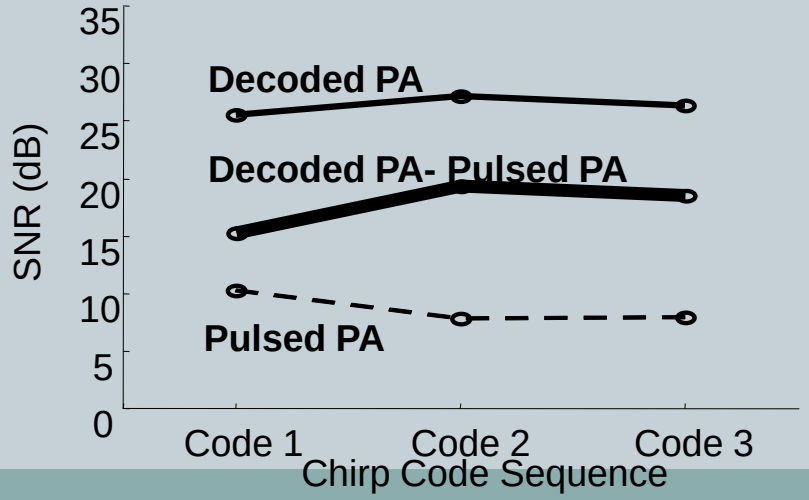


Product Development Innovations

- Cheap diode laser to replace expensive solid state laser:
  - Coded excitation

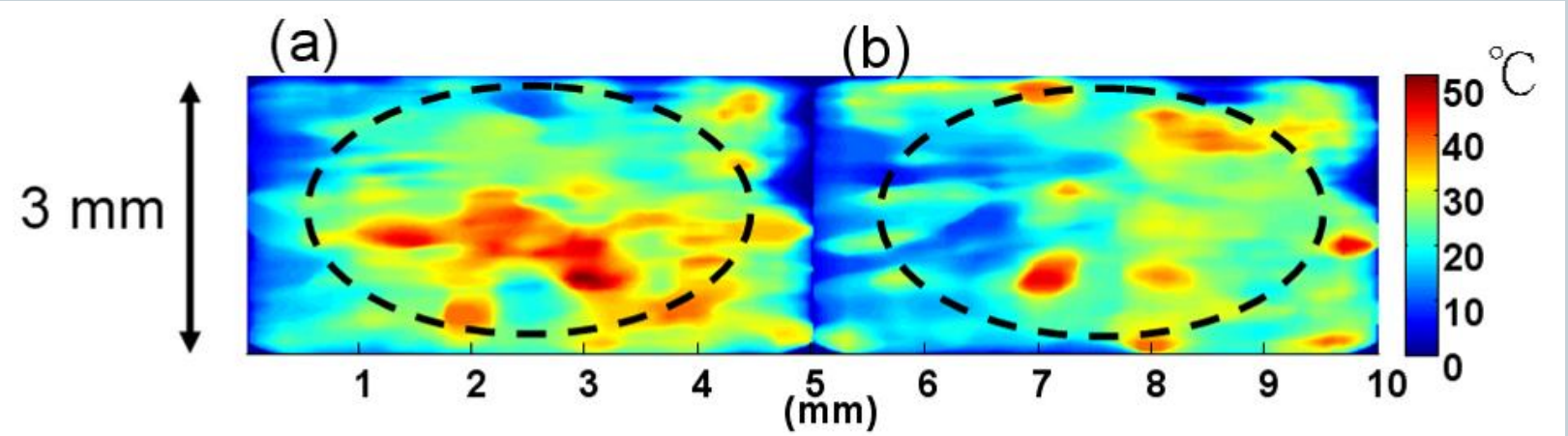






Product Development Innovations

- Real-time temperature monitoring for thermal therapy

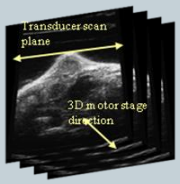


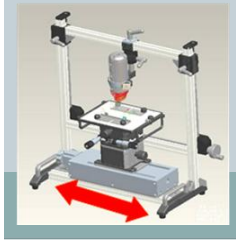
Key Success Factors

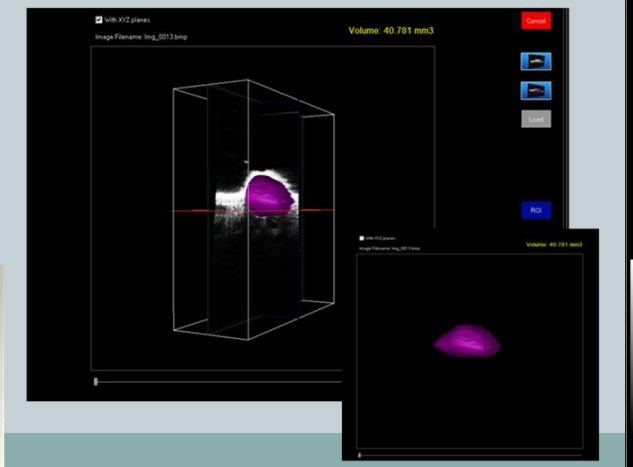
- Integration
  - Multi-disciplines
  - Technologies
- Innovations with applications in mind
  - Un-met needs
  - For people who do not have to understand the technologies
- Infrastructure
  - Foresight Taiwan
  - Entrepreneurship

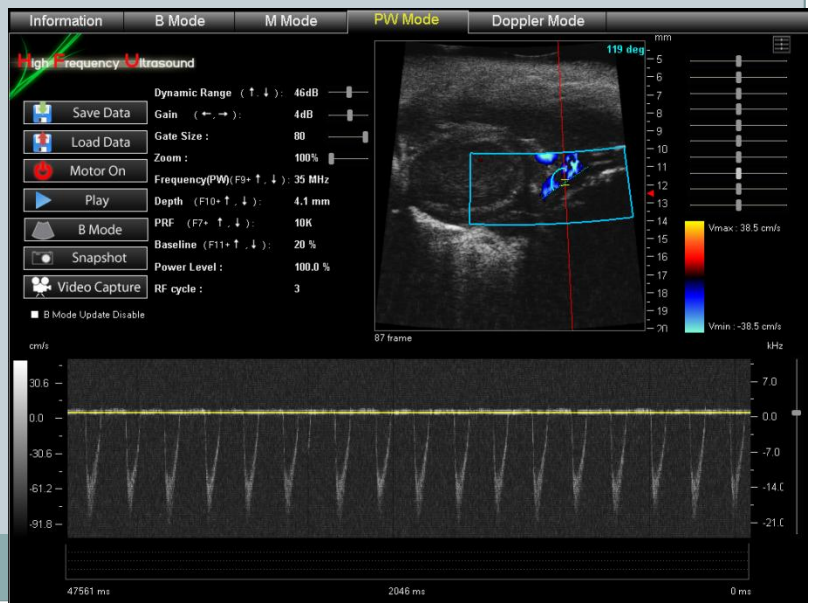
Entrepreneurship: Personal Experiences

- Mission: To provide a high performance imaging system for pre-clinical research.
- Technology transfer → Team build → "brand labeling" for world-class brand company.
- An entry to high-end biomedical devices for Taiwan.



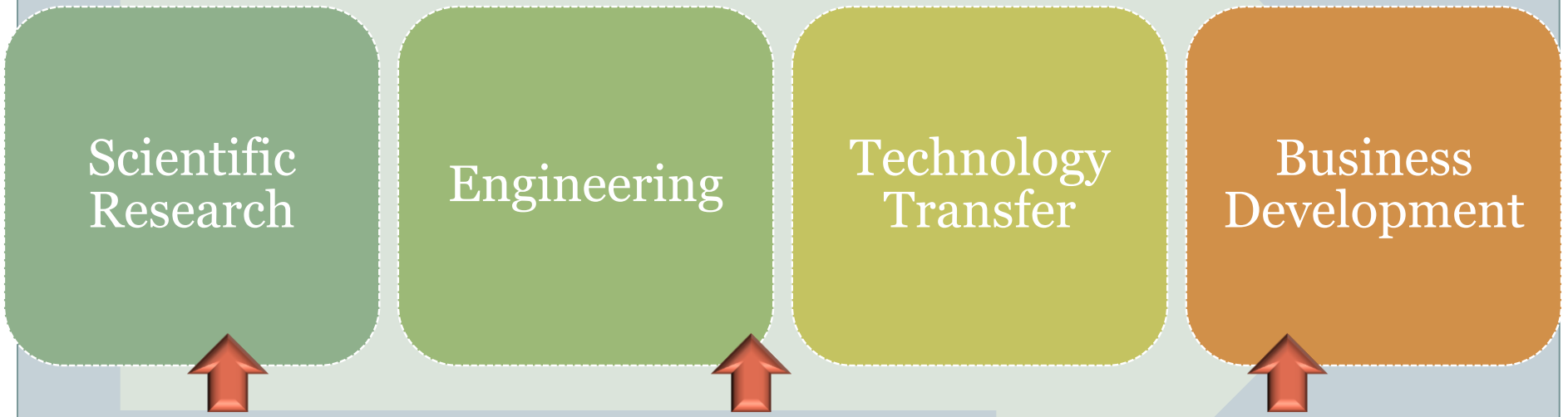






Conclusions: A Professor's Perspectives

- If you build the infrastructure, innovations will come.



Innovation Integration Infrastructure

Thank you!