



Robinson/Bae/Rajwa Group Presentation

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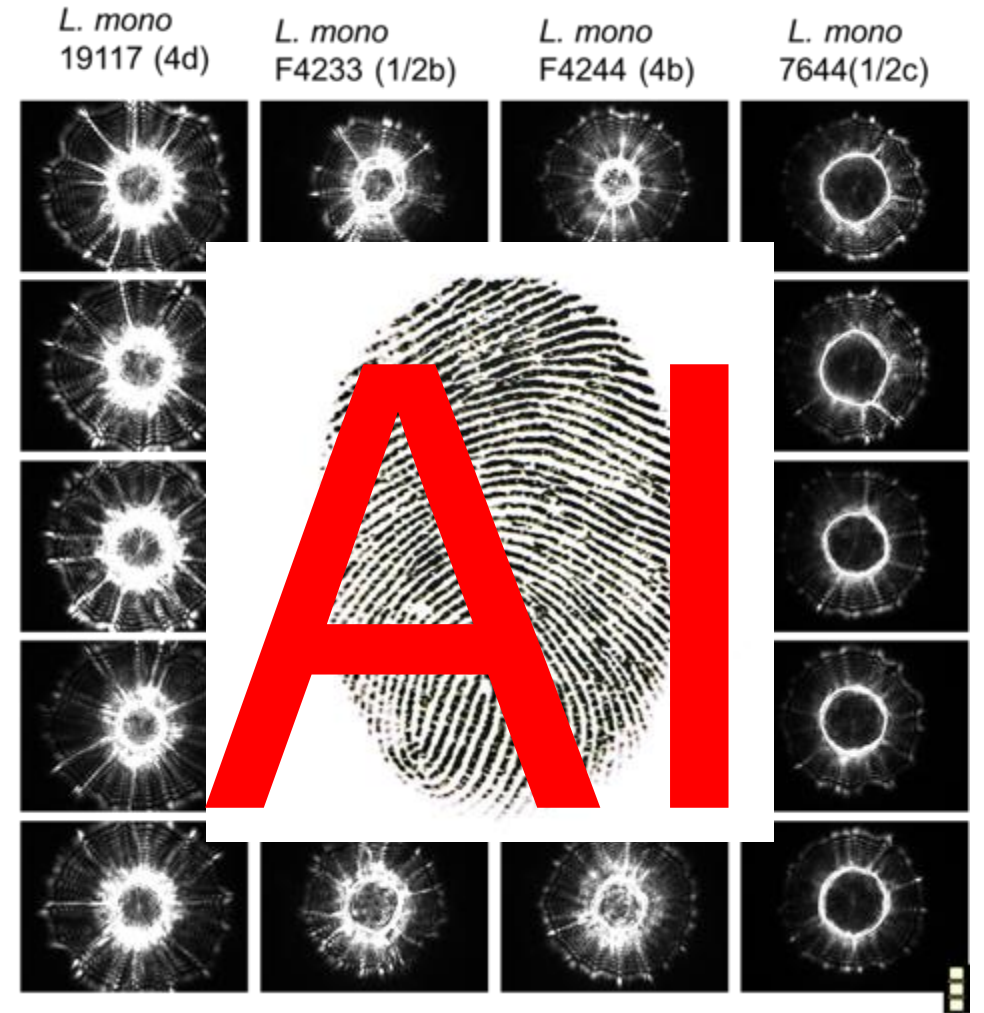
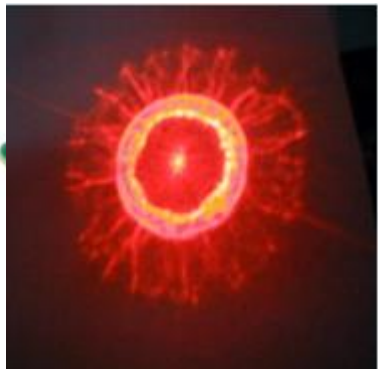
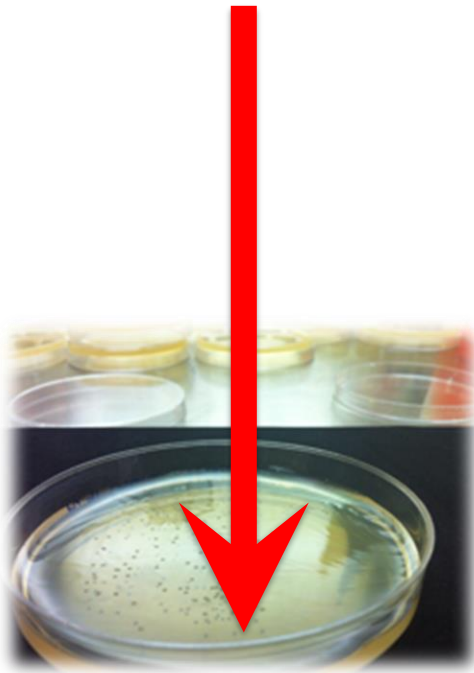
Email: wombat@purdue.edu



@Cytometryman



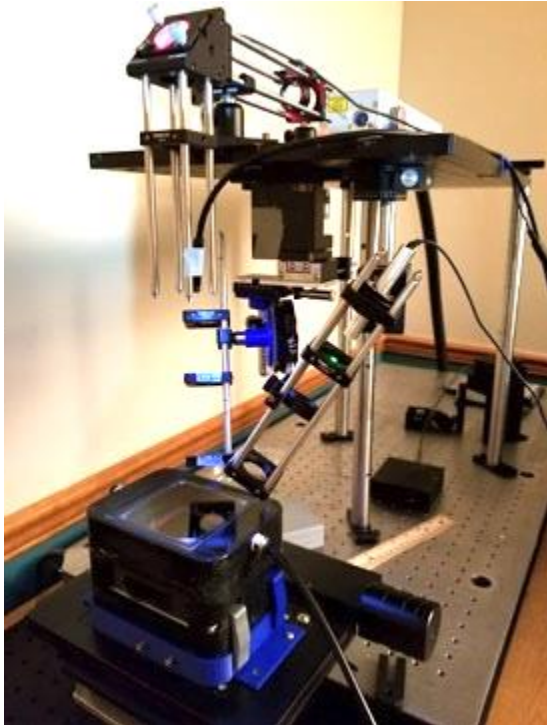
Elastic Light Scatter for Organism Identification



Machine Learning

Using Rare Earth Elements with LIBS for Rapid Assay Creation

Laser Induced Breakdown Spectroscopy (LIBS)



Periodic Table of the Elements

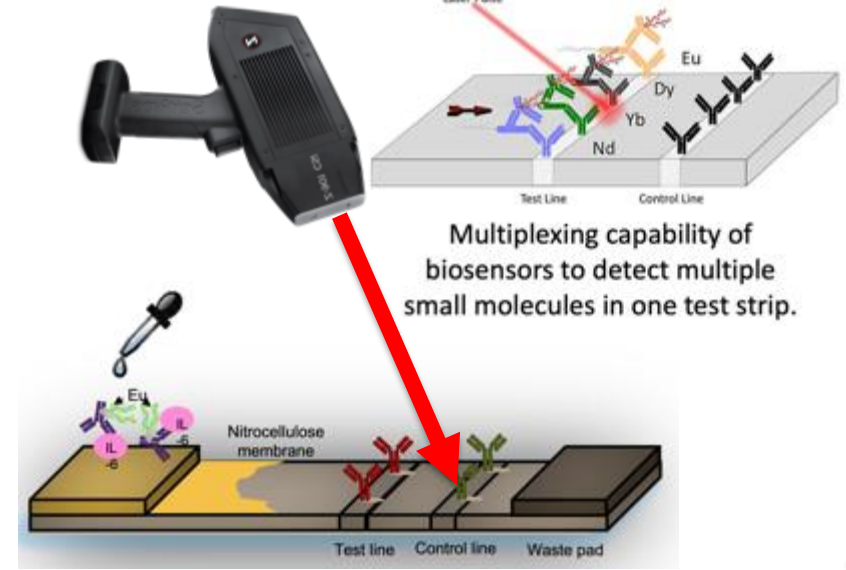
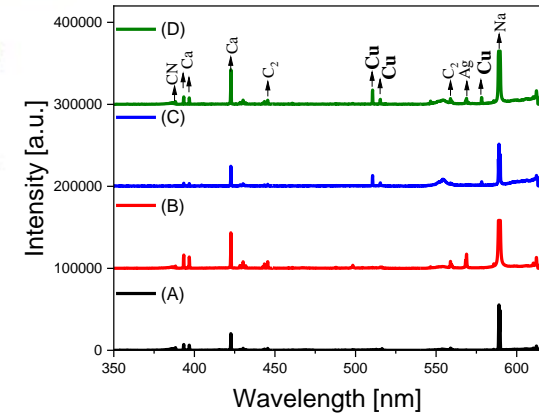
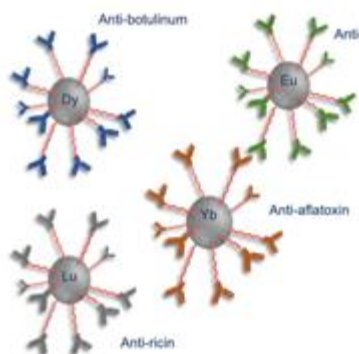
1 H Hydrogen 1.008	2 He Helium 4.003																	18 Ar Argon 39.948
3 Li Lithium 6.941	4 Be Beryllium 9.012											13 B Boron 10.811	14 C Carbon 12.011	15 N Nitrogen 14.007	16 O Oxygen 15.999	17 F Fluorine 18.998	18 Ne Neon 20.180	
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948	
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.723	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80	
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.905	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.905	54 Xe Xenon 131.29	
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanides	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [209]	85 At Astatine [210]	86 Rn Radon [222]	
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103 Actinides	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [265]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Nh Nihonium [284]	114 Fl Flerovium [289]	115 Uup Ununpentium [288]	116 Lv Livermorium [293]	117 Uus Ununseptium [294]	118 Uuo Ununoctium [294]	



Multiplexed Assay Design

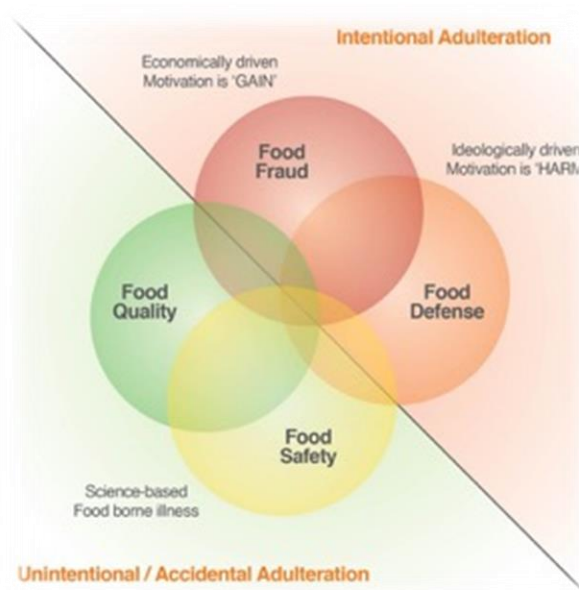
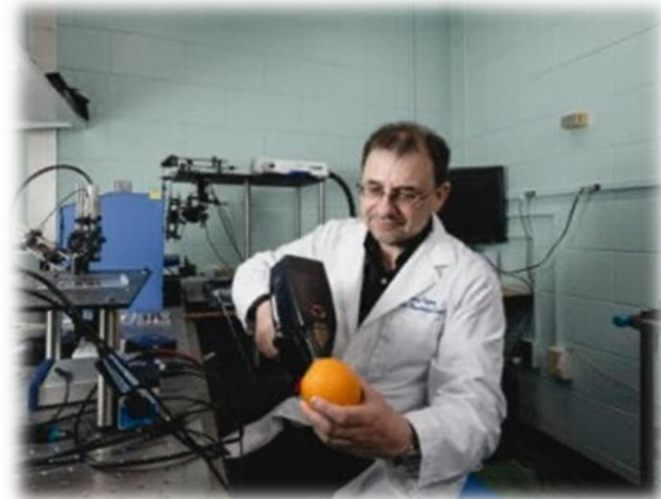
57 La Lanthanum 138.905	58 Ce Cerium 140.115	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.965	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium [257]	101 Md Mendelevium [258]	102 No Nobelium [259]	103 Lr Lawrencium [262]

Alkali Metal Alkaline Earth Transition Metal Basic Metal Semimetal Nonmetal Halogen Noble Gas Lanthanide Actinide

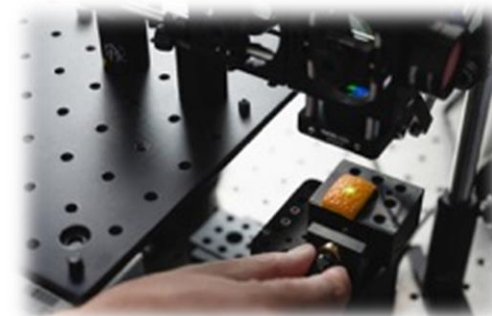


Food fraud, authentication and safety

Food fingerprinting



Dr. Bartek Rajwa



Featured in
modern farmer



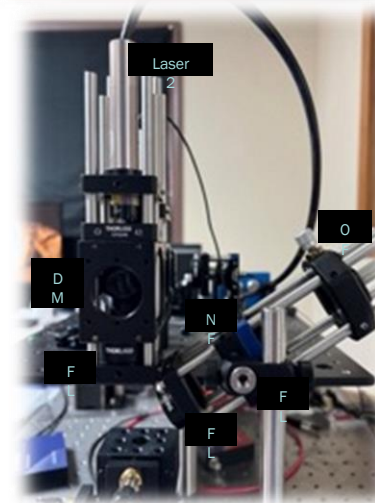
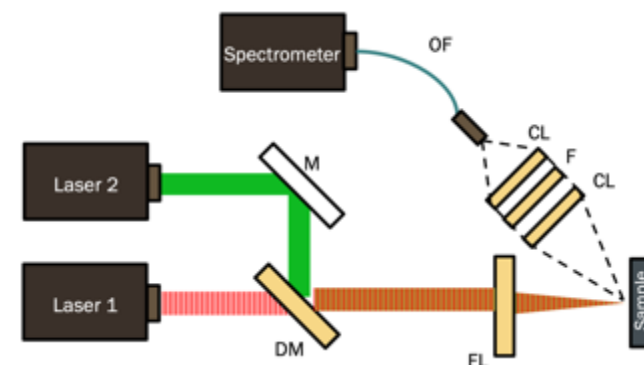
Farm. Food. Life.



The Washington Post

Laser-Induced Breakdown Spectroscopy (LIBS) is an analytical technique using a high-powered laser to vaporize a material's surface, creating a plasma.

Combining spectroscopies:
Raman & LIBS

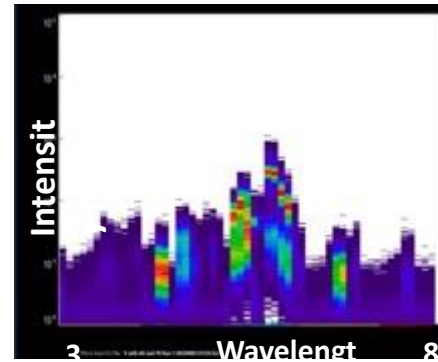
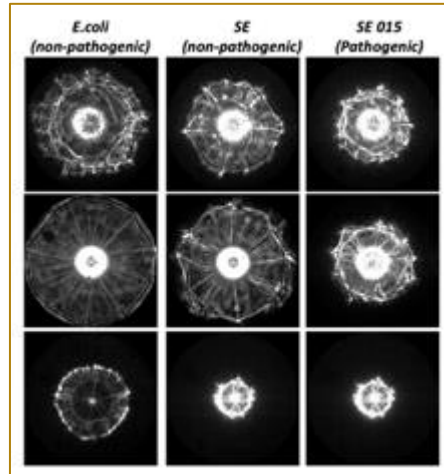


- Raman spectroscopy is a vibrational spectroscopic technique used to observe molecular vibrations, rotations, and other low-frequency modes in a system.

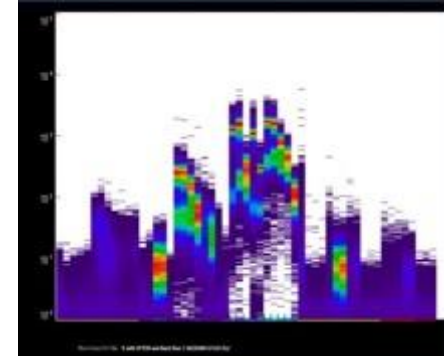


Sorting single organisms...

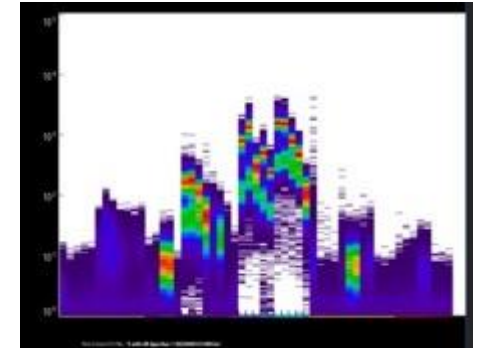
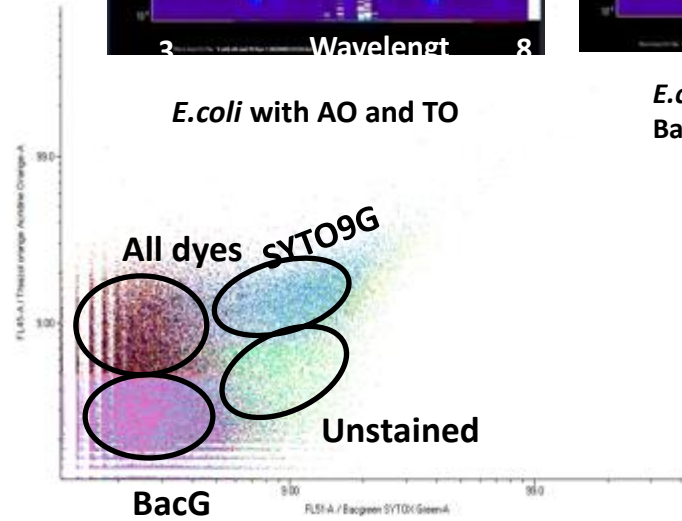
Single cell sorting – for Antibiotic Resistance



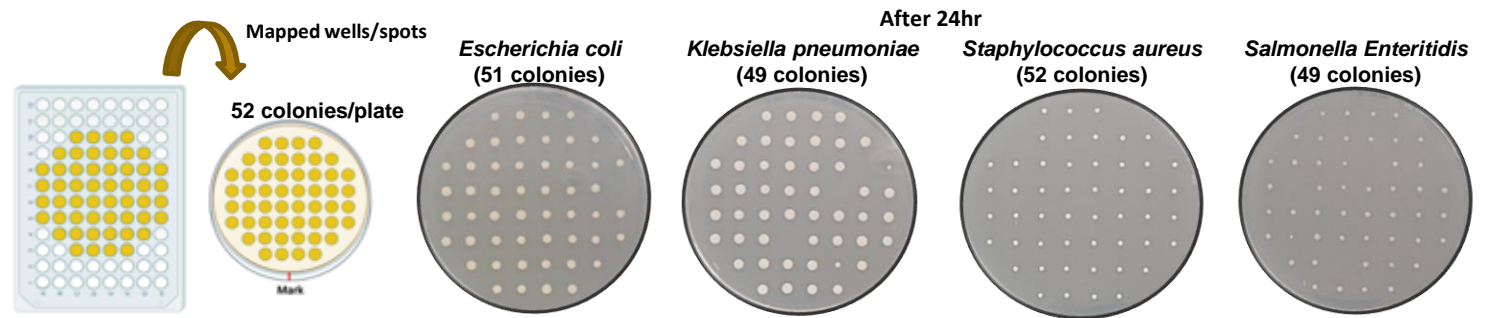
E. coli with AO and TO



E. coli with SYTO9G and BacG



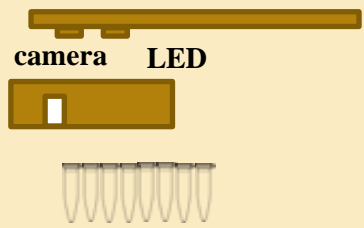
E. coli with all dyes mixed



96 well plate (reference)

Portable instrumentation for on-site detection

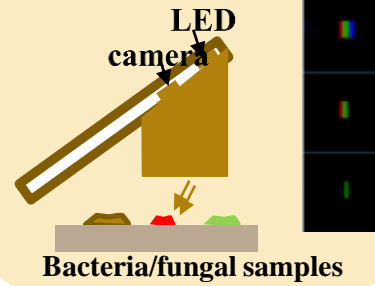
Fluorimeter



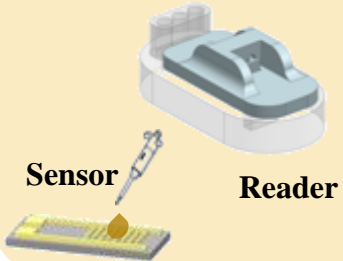
Drop in sensor



Spectrometer



Electrochemical

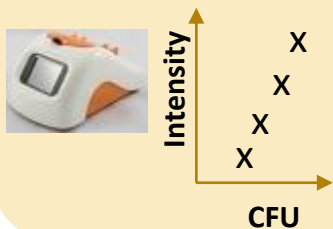


*Ubiquitous
detection
platform*

Lateral flow assay



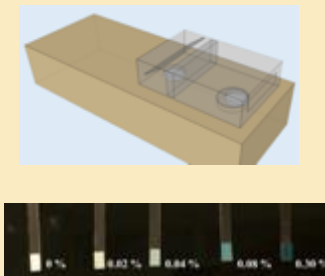
Luminometer



Portable QCM



Colorimetric



Dr. Euiwon Bae
School of Mechanical Engineering



Life Science Engineering Program

What happens when you take mechanical engineers or electrical engineers and drop them into biology space?

Lynn Hall, College of Vet Med



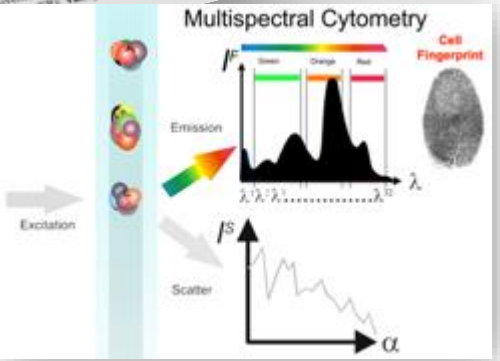
Training Environment for grad and Post Doc Engineers who are interested in working in Bio Space

Moving from idea to Industry...

2004



Licensed to...



Challenging Biology with Engineering...



2015 - Can we move BluRay concepts into Biology Space?



13 Issued Patents all focused on Single Photon in Diagnostics

Challenge: Can we move biology focus on PMTs to Super fast single photon *Quantum Cytometry* ?



10² times faster



42 Ch Single Photon Array

Challenge: Can Miftek get funding?

NIH, NSF, IEDC Investors



Miftek 6 laser System prototype

Success: Significant funding in 2022

Miftek has 10 FT Employees (**All Purdue Alums**)

Building a next-gen high res, high complexity diagnostic instrument in Purdue Research Park



Masanobu Yamamoto (Established Sony Life Sciences Visited Purdue in 2008-9

(Now Adj Professor BMS)



Sony PlayStation 2006



Emmy in 2010

