CNEC | Consortium for Nonproliferation Enabling Capabilities

ILLINOIS

S&O Thrust Area Highlights

Kathryn Huff
University of Illinois at Urbana Champaign

2018 CNEC Workshop
February 8-9, 2018
Raleigh, North Carolina

NNSA National Nuclear Security Administration

Illinois

Research

- Virtual environment radiation visualization
- Machine Learning algorithms for single source detection
- Fuel Cycle S&O Simulation with Cyclus
- High precision timing detectors for muon scattering tomography

Productivity

Current Students

- 4 CNEC Grad Students
- 1 CNEC Fellow
- 4 CNEC undergraduates
- 2 national lab internships (2018)

Updated Faculty Team



ILLINOIS

NNSA National Nuclear Security Administration

CNEC

Purdue

New Nuclide Identification Methods

- **Neural Network Method**
- Library of Nuclides represented by Neural Networks
  - Dimensionality Reduction (1024 parameters -> 50 parameters)
- **Fuzzy Logic Method**
- Fuzzyfying nuclide photopeaks
- Rule Based Identification
  - Computationally fast and cheap method

Degrees

- 2 Phd Students
- 2 M.S. Students

Publications

- 1 M.S. Thesis
- 1 Book Chapter
- 3 Journal Papers
- 11 Conference Papers

Interactions

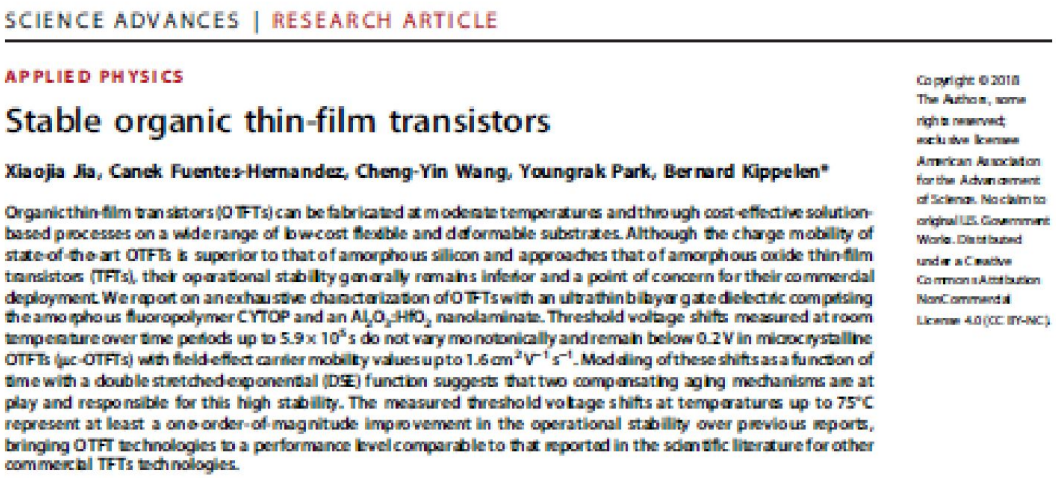
- 2 Interns in National Laboratories
- 2 Seminar Talks given at Purdue by CNEC visitors

Georgia Tech: Accomplishment 1

New paper on organic transistor stability published in Science Advances and provisional US patent filed:

Stable organic thin-film transistors

http://advances.sciencemag.org/content/4/1/eaao1705



SCIENCE ADVANCES | RESEARCH ARTICLE

APPLIED PHYSICS

Stable organic thin-film transistors

Xiaojia Jia, Canek Fuentes-Hernandez, Cheng-Yin Wang, Youngrak Park, Bernard Kippelen*

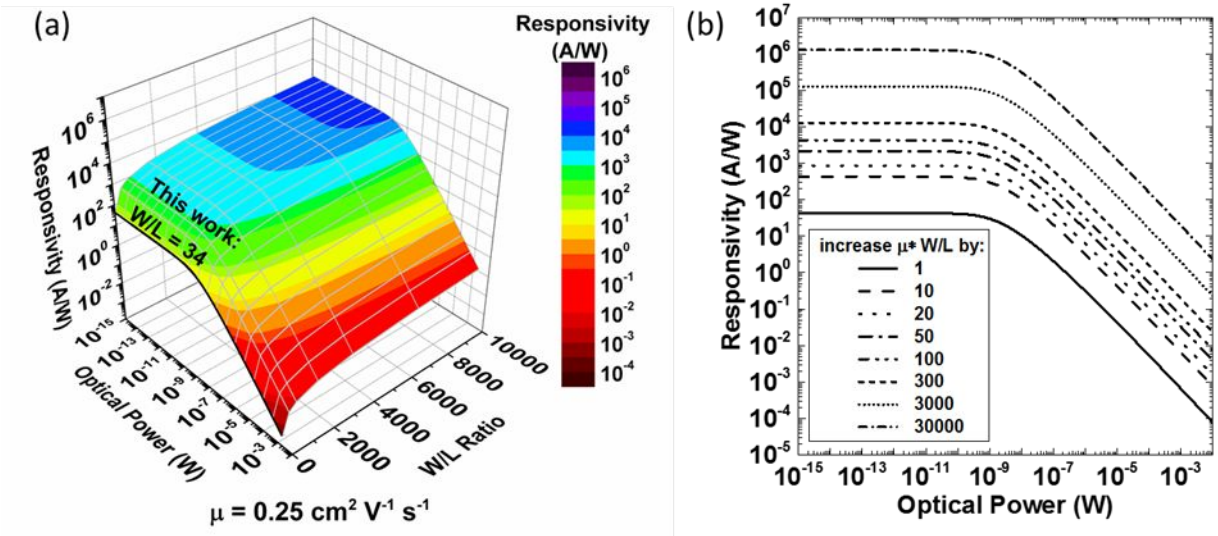
Organic thin-film transistors (OTFTs) can be fabricated at moderate temperatures and through cost-effective solution-based processes on a wide range of low-cost flexible and deformable substrates. Although the charge mobility of state-of-the-art OTFTs is superior to that of amorphous silicon and approaches that of amorphous oxide thin-film transistors (TFTs), their operational stability generally remains inferior and a point of concern for their commercial deployment. We report on an exhaustive characterization of OTFTs with an ultrathin bilayer gate dielectric comprising the amorphous fluoropolymer CYTOP and an Al_2O_3:HfO_2 nanolaminate. Threshold voltage shifts measured at room temperature over time periods up to 5.9×10^5 s do not vary monotonically and remain below 0.2 V in microcrystalline OTFTs (μc-OTFTs) with field-effect carrier mobility values up to 1.6 $cm^2 V^{-1} s^{-1}$. Modeling of these shifts as a function of time with a double stretched-exponential (DSE) function suggests that two compensating aging mechanisms are at play and responsible for this high stability. The measured threshold voltage shifts at temperatures up to 75°C represent at least a one-order-of-magnitude improvement in the operational stability over previous reports, bringing OTFT technologies to a performance level comparable to that reported in the scientific literature for other commercial TFTs technologies.

CNEC relevance: Organic thin-film transistors are being used to provide amplification in novel organic photodetectors and will be used to develop novel radiation detectors for dosimetry

Canek Fuentes-Hernandez, Xiaojia Jia, Wen-Fang Chou, Youngrak Park, Jacob Inman, John Stooksbury, Nolan Hertel and Bernard Kippelen

Georgia Tech: Accomplishment 2

- Novel organic photodetector geometry integrating an organic photodiode into an organic thin-film transistor structure demonstrated and characterization completed.
- Manuscript and provisional patent completed. To be filed soon.



CNEC relevance: Novel organic-based photodetector with high responsivity has been developed to provide large amplification of small scintillation signals.

Canek Fuentes-Hernandez, Xiaojia Jia, Wen-Fang Chou, Youngrak Park, Jacob Inman, John Stooksbury, Nolan Hertel and Bernard Kippelen

NCSU

Retrospective Dosimetry and Nuclear Assay

Paper

PRELIMINARY WORK TOWARD A TRANSURANIC ACTIVITY ESTIMATION METHOD FOR RAPID DISCRIMINATION OF ANTHROPOGENIC FROM TRANSURANIC ACTIVITY IN ALPHA AIR SAMPLES

S. Joseph Cope and Robert B. Hayes*

Abstract—**Radon (^{222}Rn) and thoron (^{220}Rn) progeny (primarily bismuth and polonium) are known interferents when rapid evaluation of transuranic content on air filters is of interest. These complexities stem from the overlapping energies of the progeny alpha particles onto the transuranic region of interest (3–5.5 MeV) where naturally-occurring alpha emitters can overwhelm the spectra. Due to the immediacy of the alpha counting methods employed, coupled with the half-life of thoron progeny dominated**

scenarios, portable air samplers are rapidly deployed in an effort to determine airborne radioactivity concentrations. Anthropogenic alpha emitters have a higher risk per activity than beta emitters and are of particular interest at air concentrations comparable to that of natural radon progeny; the anthropogenic alpha emitters of interest generally have very long half-lives.

S. J. Cope and R. B. Hayes, “Preliminary Work Toward a Transuranic Activity Estimation Method for Rapid Discrimination of Anthropogenic from Transuranic Activity in Alpha Air Samples,” Health Physics, 2017.

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