SAND2008-4937P

Remotely Interrogated Passive Polarizing Dosimeter

LDRD Day 2008

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Overview

PROJECT GOAL

Develop a device capable of measuring ionizing radiation dose while being remotely interrogated

MOTIVATION

- **Safe stand-off from dangerous environment**
- **Passive monitor not requiring external power**
- **Innocuous device to avoid alerting others**

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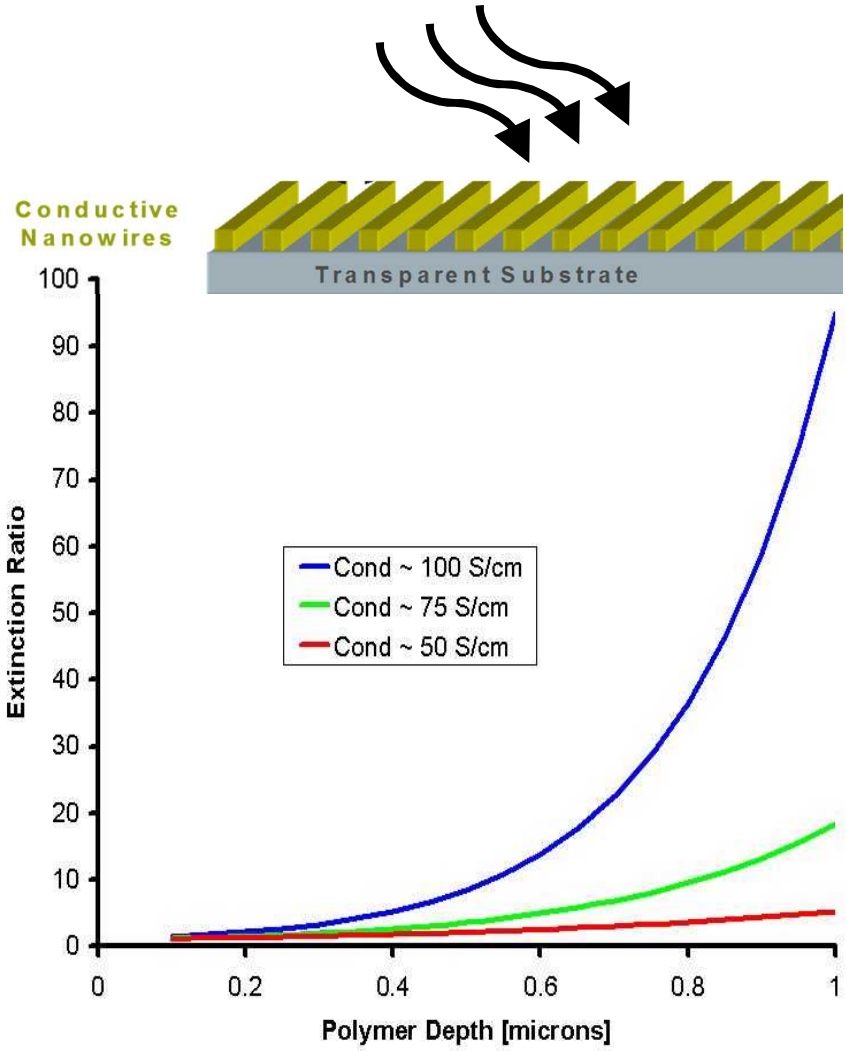
Approach

- Use a conductive polymer based IR polarizer
- Conductivity of material changes with absorbed dose
- Conductivity directly relates to extinction ratio of polarizer
- Interrogate polarizer actively (laser) or passively (polarimetric imaging)



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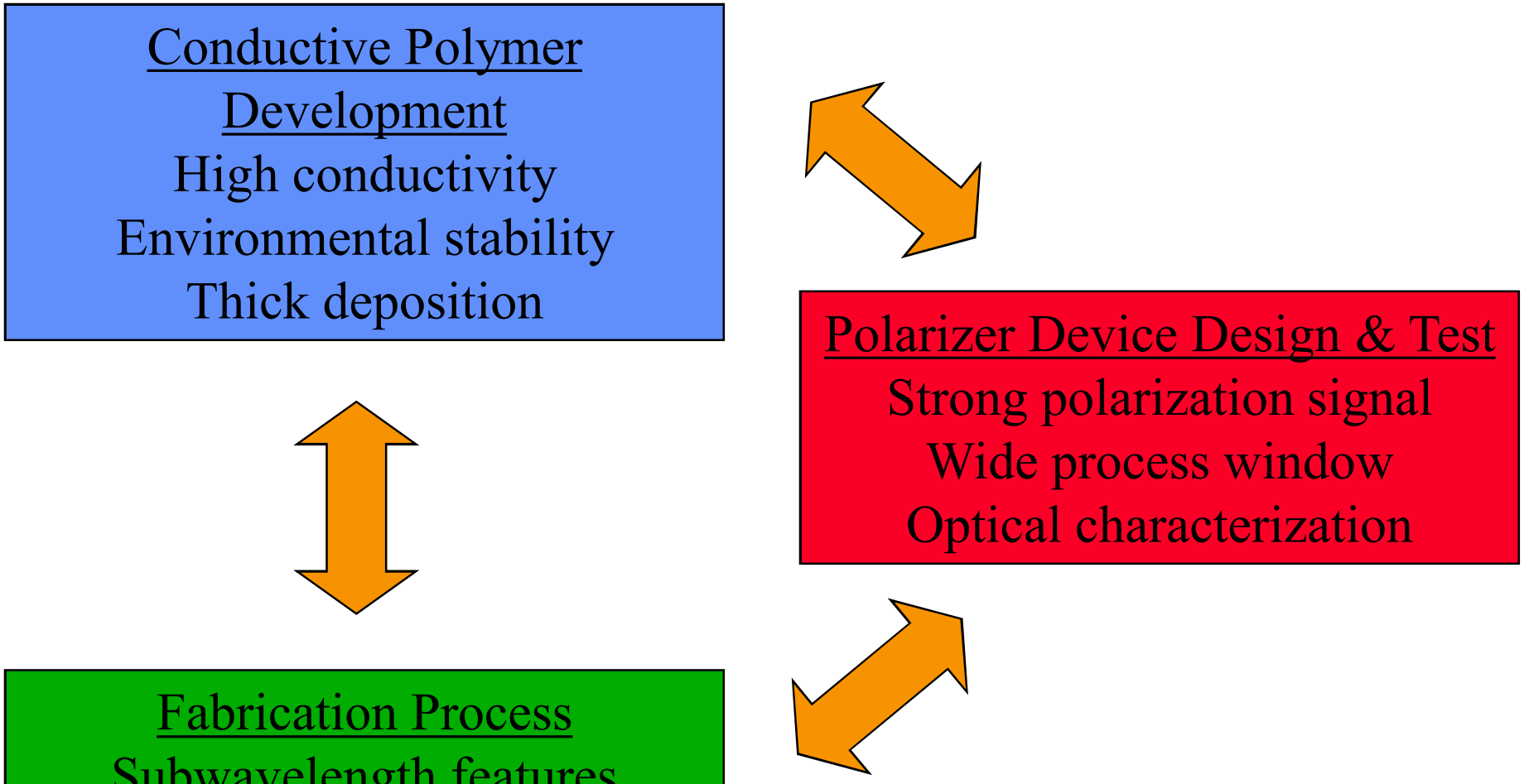
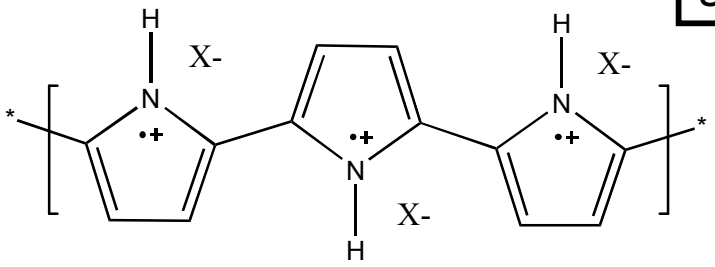
Interdisciplinary Research

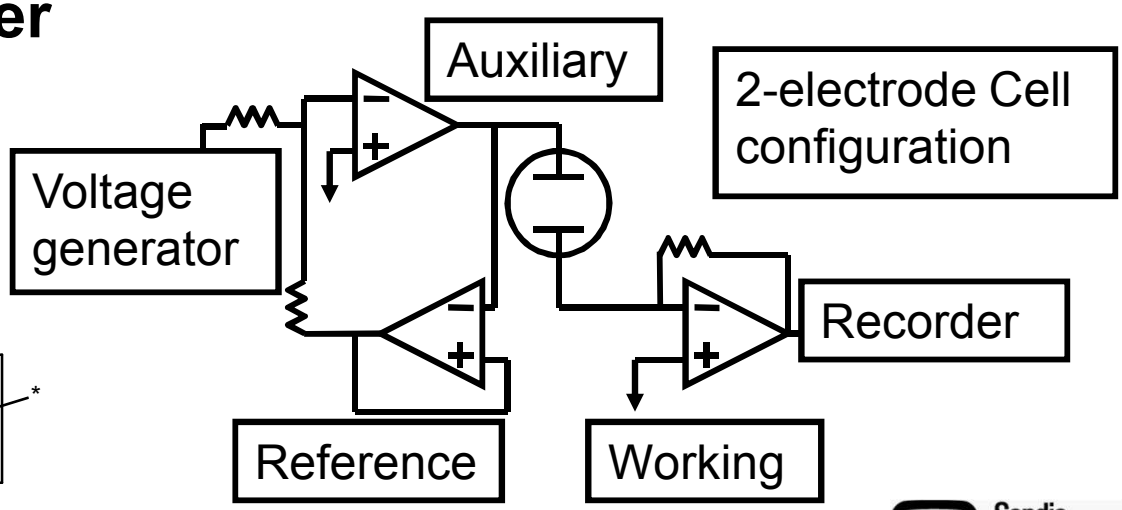


Results – Conductive Polymer Development

- **Polymer film grown in two-electrode electrochemical cell using current control**
  - **Films up to 2.5 μm successfully deposited**
  - **Conductivities ranged from 10 – 100 S/cm**
- **Underpotential deposition of silver used to roughen surface and enhance film adhesion**
- **Films were not adversely affected by acetone rinse or photoresist developer**

Pyrrole





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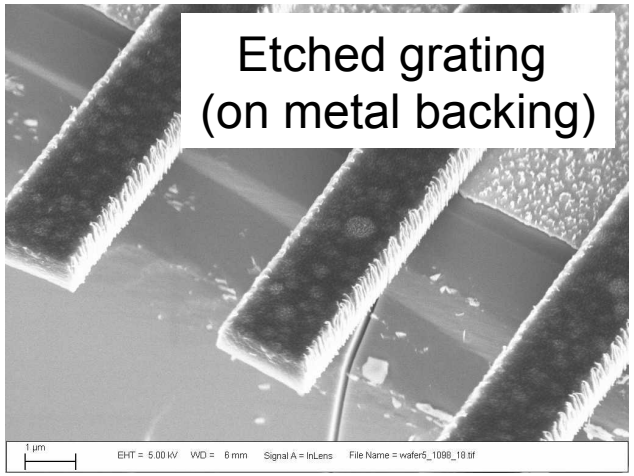
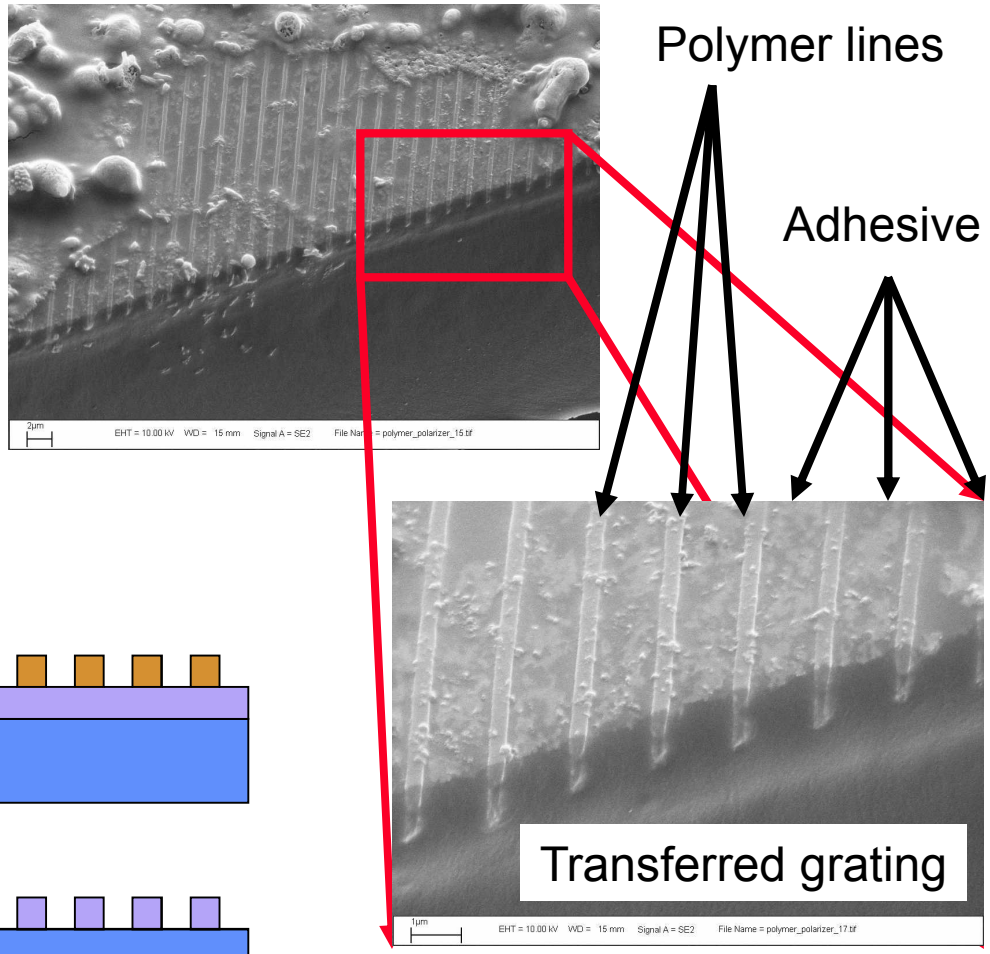
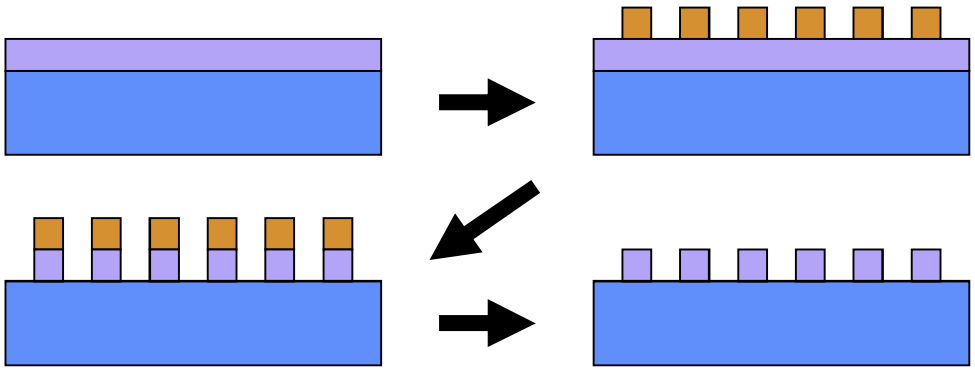
Results - Device Fabrication





Basic Process Flow



Polypyrrole Photoresist Sub./Seed Layer

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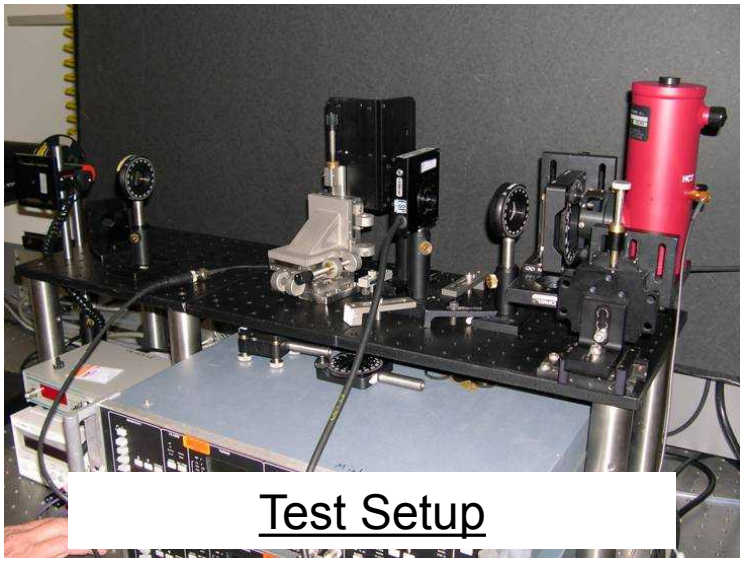
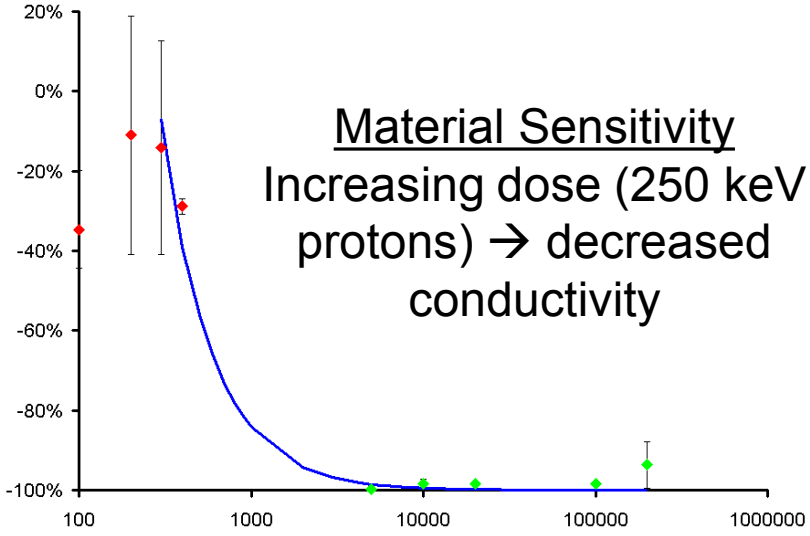
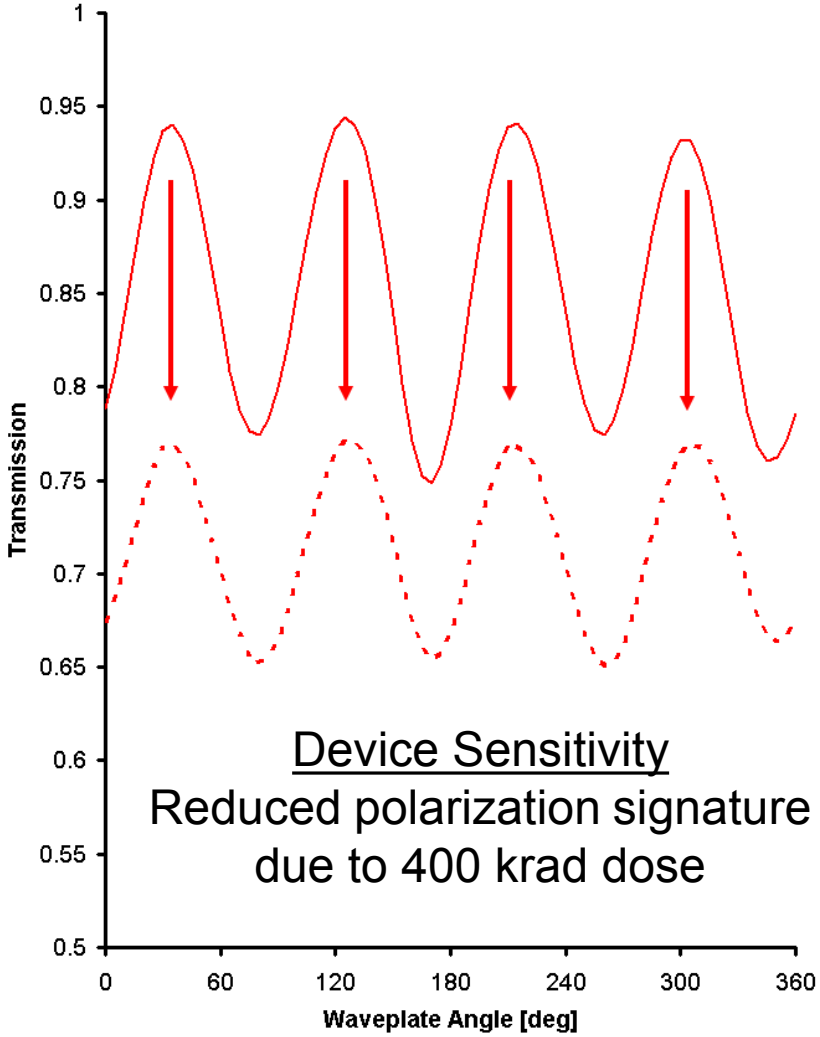
Results – Radiation Sensitivity



Test Setup



Material Sensitivity
Increasing dose (250 keV protons) → decreased conductivity



Device Sensitivity
Reduced polarization signature due to 400 krad dose

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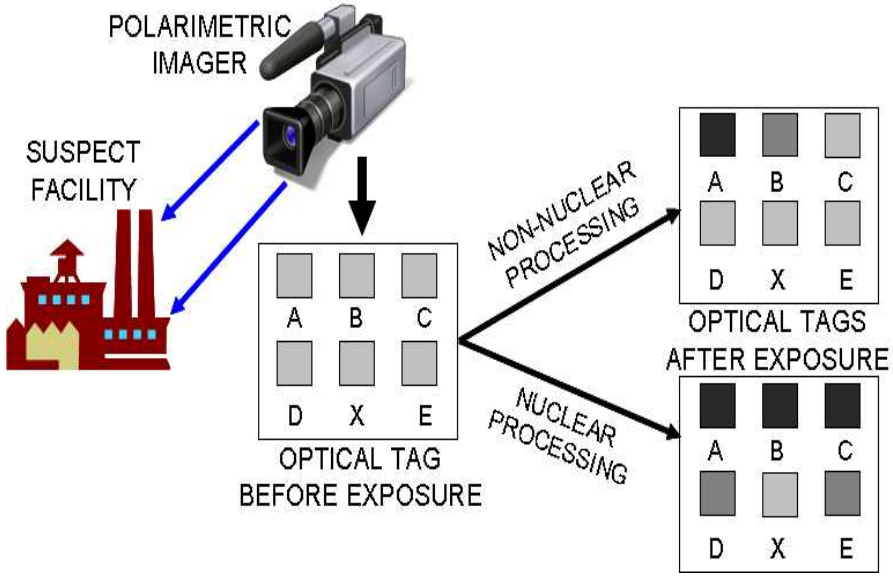
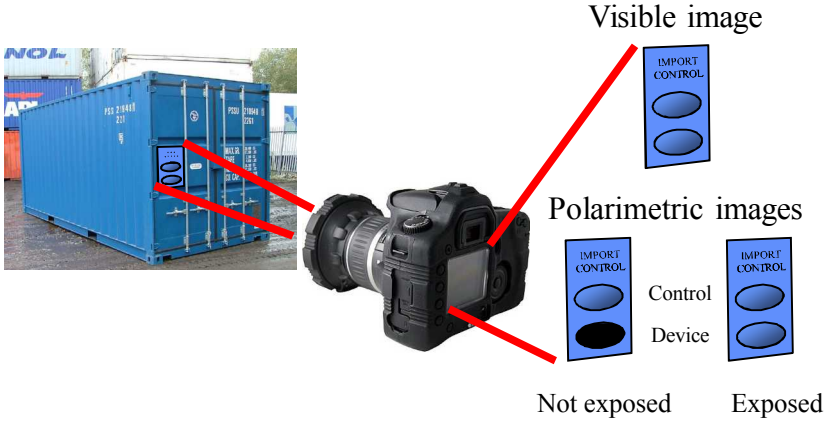
Impact – Application Examples

FACILITY MONITORING

- Interior, innocuous labels acting as radiation monitors
- Exterior, passive devices interrogated remotely





SHIPPING, PORT SECURITY

- Label on cargo containers
- Fast screening of incoming material

ANTI-TAMPERING LABELS

VEHICLE TAGS

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