Deposited Blocking Filters for X-ray Detectors

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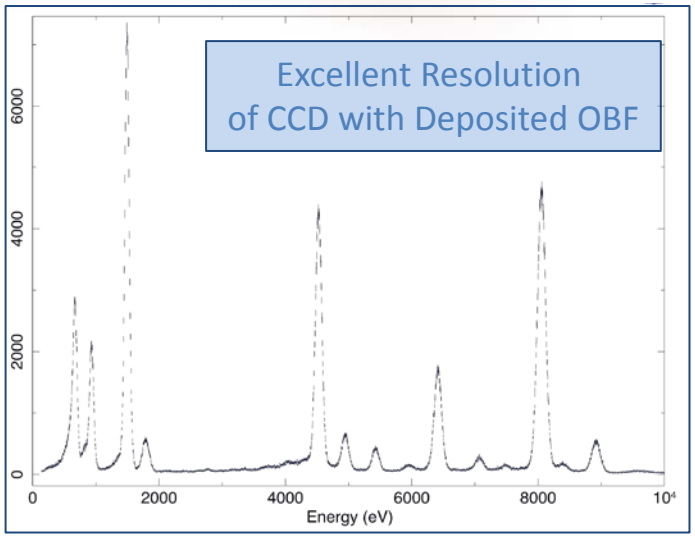
Objectives and Key Challenges:

- Silicon Imaging X-ray detectors require filters to block noise/background from UV and optical light
- Filters must be thin (<300 nm) to transmit X-rays
- State-of-the-art, free-standing filters use fragile, thin substrates
- Objective: deposit blocking filter directly on CCD X-ray detector, eliminating substrate

Significance of Work:

- Filter deposited on detector requires no fragile substrate
- Allows cheaper, more robust sensors (no vacuum housing!)
- Improves QE & makes larger focal planes practical
- Challenges:
- Deposit filter directly without compromising CCD performance
- Deposit sufficiently thin, uniform filters



Approach:

- Exploit existing stocks of (engineering grade/flight spare) X-ray CCD detectors at MIT Lincoln Laboratory
- Screen, thin, passivate, package & apply filters to detectors
- Filter is Al with AlO_2 cap
- Start thick (220 nm Al), get progressively thinner
- Use existing MIT facilities for X-ray characterization
- Use existing & upgraded facilities for optical characterization

Key Collaborators:

- MIT Kavli Institute (Bautz, Kissel et al.)
- MIT Lincoln Laboratory (Suntharalingam, Ryu, Burke, O'Brien)

Current Funded Period of Performance:

Jul 1, 2012 – Jun 30, 2015

Recent Accomplishments:

- Tested devices with alternative back side treatment (10nm MBE vs. 20nm MBE of previous) and 70nm & 100nm thick Al OBF. Optical blocking as expected; OD7 pinhole fraction 0.5%; X-ray performance similar to 20nm MBE devices
- Identified leakage paths through CCD support wafer at long ($\lambda \gtrsim 1000$nm) wavelength, with detection efficiency ~2.5%
  - Significant for REXIS (large visible-light flux)
- Developed underside coating as countermeasures for leakage:
  - Aluminum or 'Z307' paint; REXIS will fly 1 of these

Next Milestones:

- Support tests of REXIS flight CCDs/OBFs, achieve TRL-6

Application:

Every X-ray imaging or grating spectroscopy mission

- Explorers (Lobster, Arcus…)
- "Probes" (AEGIS, N_XGS, AXSIO, WFXT…)
- Flagship (Athena...)

TRLin = 5 ***TRLcurrent = 5*** ***TRLtarget = 5***