Image sensors for photon science

+ RIKEN SACLA XFEL facility provides the shortest wavelength X-ray laser (0.06nm) in the world

Key challenges

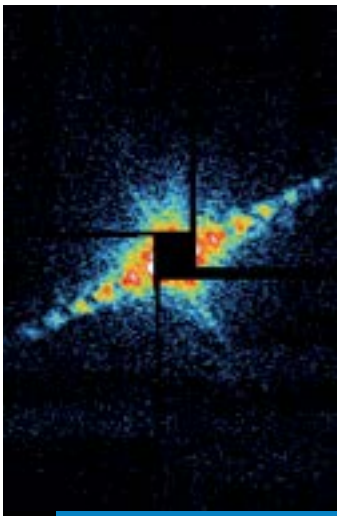
Image sensors for photon science have a number of very specific requirements that are significantly different to imaging applications and require different designs and technology:

- Thick silicon is required to give a good sensitivity to X-ray photons with energies of up to 20keV
- Devices must be radiation hard to survive the high radiation doses that can be encountered in XFELs. A custom process is used for these devices
- Very high peak signal capability and fast readout is required to work with the very high intensity photon sources now in operation.

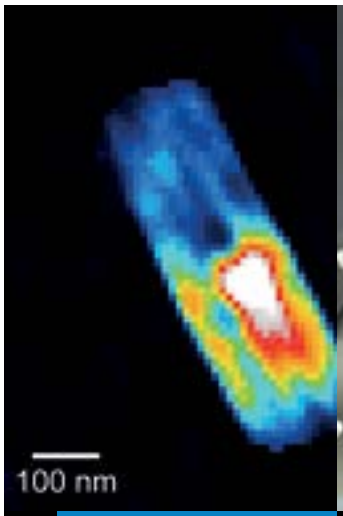
Teledyne e2v's new generation of sensors are specifically designed for XFEL applications. By working with Riken, we have shown that we can successfully design and manufacture CCDs that meet all of these requirements.

Future sensor development

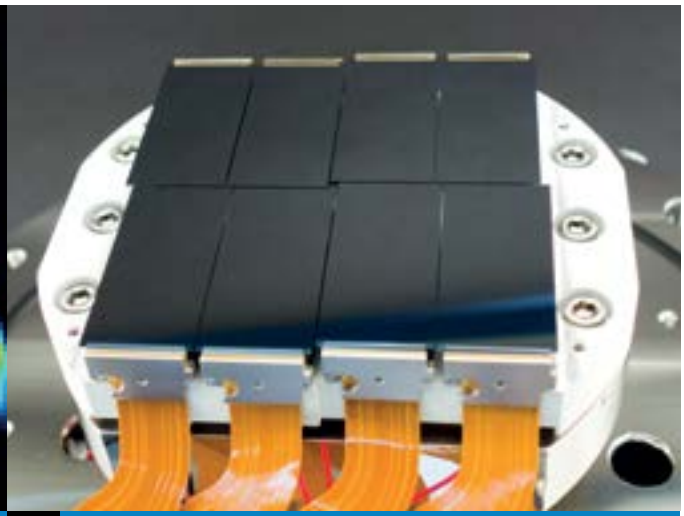
Further increases in pulse rates require sensors with much higher readout rates, which are not currently possible with CCDs. Teledyne e2v's high speed CMOS design capability, combined with our knowledge of the use of thick silicon in high radiation environments, makes us an ideal partner for the ever more demanding photon science applications.



\+ Diffraction pattern coming out from CCDs



\+ Protein structure derived from the diffraction pattern



\+ CCD262-50 is used in RIKEN SACLA XFEL facility

XFEL CCD sensors

Description	CCD262-50	CCD292-50	CCD263-50
Pixel size	50 µm	50 µm	50 µm
Device type	Front illuminated	Back illuminated	
Depletion depth	50 µm	300 µm	
System noise* (ph@6keV)	0.06 – 0.15	0.12 – 0.15	0.02 – 0.037
Peak signal* (ph@6keV)	2500 – 3000	2100	970
Nominal QE* (%@6keV)	77	100	
Nominal QE* (%@12keV)	19	73	
Comments	1st generation	BetterQE Application SFX	Lower noise Lower peak signal App. XQO, XAFS

All photographs are courtesy of RIKEN.
*Noise and Peak signal are given in equivalent signal from a photon with an energy of 6keV.