The advantages of CMOS sensors over CCD cameras for the imaging of gels and blots

Recent advances in CMOS technology has opened the way for numerous applications in science and industry which bring a number of technical advances in performance and benefits to existing imaging areas. Pop-Bio Imaging have pioneered the use of this new technology to make significant improvements over the existing CCD camera technology in the capture and imaging of gels and blots.

The rise of the CMOS sensor

CMOS technology is probably known to most as the heart of their mobile phone camera. Here we have seen image quality and features improve significantly over recent years. Today anyone can capture near perfect images from their mobile devices. It is probably this market alone which will account for a near doubling of the market size for CMOS over the next 5 years.

The CMOS sensor has outstanding imaging qualities in the visible spectrum, is low cost, small and easy to control. This makes the CMOS sensor perfect for the consumer market where costs are particularly important. However these same qualities are now being harnessed in the scientific field where the ubiquitous CCD camera has for so long held sway. The CMOS sensor offers higher resolutions, low noise and high speed outputs which can now outperform equivalent CCD's but at significantly lower cost.

Using the CMOS sensor for science research

In the scientific field more manufacturers are finding the CMOS sensor can give higher levels of quality and are considerably easier to handle than traditional CCD cameras. The higher resolutions offered by the CMOS sensor and their faster data flow speed have multiplied in recent years such that faster more efficient processors are needed. Fortunately this is another area where technology has advanced now producing good quality, high performance processors which are not only powerful but are also smaller and at lower cost. With scientific budgets being squeeze finding good quality instrumentation that fits both the budget and scientific performance levels has become more difficult. Hence, lower cost imaging but with improved performance like the Pop-Bio Imaging Vü systems are now the perfect solution.

The CMOS advantage

The key features of the CMOS sensor – price, resolution, speed, low noise – are all paramount in many scientific applications and especially so in the field of gel and blot imaging. Pixel size has also increased to the point where they can be as large if not bigger than CCD's. The extremely low cost

of the CMOS sensor means it is also very easy to multiple the number of sensors being utilised but at very little increase in cost since the sensors are considerably cheaper than their CCD counterparts. Using high output LED's as lighting sources further enhances the ability of the CMOS sensor to capture high quality images. Also, but very importantly, CMOS technology and image processing now makes it possible to take successful images in low light levels. Just look at the ability of the mobile phone to capture night-time images without noise and with sharp definition. These are all features required in the area of gel and blot imaging.

CMOS developments

The major CMOS manufacturers are constantly improving the performance of these sensors. A few years ago no one would consider using a CMOS sensor in a gel documentation system. However, that has now changed. Using line-scanning it is now possible to use these sensors in low-light, high performance applications such as chemiluminescent Western Blot image capture. Clever use of how the line scanner can be controlled to capture low level light and to monitor light level output has revolutionised this technique. The acquisition of accumulated exposures of the sample effectively increases the integration time to collect the signal from the gel or blots and hence is ideal for a low light application. Even with such a low noise sensor no Peltier cooling is required. This overcomes one of the major disadvantages of the CCD camera where the use of significant cooling is required to remove electronic noise during the image capture process.

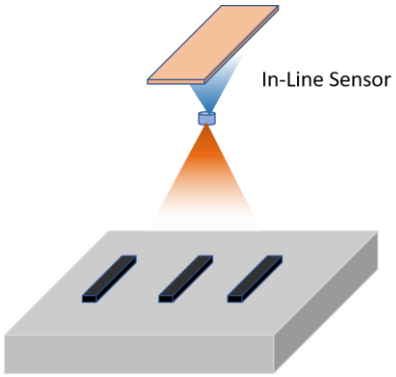

Fig1. An in-line CMOS sensor mapping head

Additionally, the CMOS sensor allows the summing of the signal output with no increase in noise – unlike in the CCD where the summing of a series of captured images [series capture] results in an increase in the signal to noise ratio and a decline in image quality.

Pop-Bio Imaging are one of the first companies to recognise the significant advantages that the CMOS sensor offers above that the older technology CCD camera. Using CMOS, fluorescent samples which emit extremely weak signals can be imaged with ease while the CCD often struggles in these situations. Placing the CMOS sensors very close to the sample also aids the ability to collect weak signals. Something the CCD camera cannot do because of the inherent optical problems and the need to use additional lenses and filters.

CMOS manufacturers are now looking at specific sensors for use in IR detection and which Pop-Bio Imaging will eventually use in high performance detection of IR gels and blots.

The Pop-Bio Imaging benefits

Pop-Bio Imaging are among the first scientific instrument manufacturer to harness the power and effectiveness of the CMOS sensor. The key benefits are significant when compared to the traditional CCD camera technology for gel and blot imaging which is now over 30 years old. Which other industry has stood still for 30 years while vast improvements have been made which could help the end user?

- In-Line sensors rather than CCD sensor camera which require significant lenses and filters to accurately capture signals
- Mega resolution which give enhanced spatial resolution and options for pixel summing with no noise as in the CCD sensor
- Lower cost sensors which replace high cost cameras making systems more affordable to more users.
- A very high degree of automation is now possible since CMOS is considerably more controllable than CCD.
- Compact CMOS sensors can be built into smaller devices [like mobile phones] and hence take up a fraction of the footprint of a typical gel documentation system.