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Science & Environment

Digital imaging inventors win engineering's £1m Queen Elizabeth Prize

Winners developed technology used in all today's digital cameras and smartphones



Moment in time: Michael Tompsett, Eric Fossum and Nobukazu Teranishi will share the prize with George Smith, not pictured. Their inventions made the selfie possible

YESTERDAY by: **Clive Cookson**, Science Editor

Four engineers responsible for developing the imaging sensor [technology \(https://www.ft.com/companies/technology\)](https://www.ft.com/companies/technology) used in all today's digital cameras and smartphones will share the £1m Queen Elizabeth Prize, the world's top award for engineering innovation.

Working in the US and Japan between the 1970s and 1990s, the winners developed a series of electronic sensors that transformed digital imaging and made most film-based photography redundant. First came the charge coupled device (CCD), then the pinned photodiode (PPD) and finally the complementary metal oxide semiconductor (CMOS).

They are: Michael Tompsett, 77, a Briton working in the US; two Americans, Eric Fossum, 59, and George Smith, 86; and Nobukazu Teranishi, 64, of Japan. The prize is awarded every two years with funding from a range of industrial donors.

Mr Tompsett, now retired after a career in electronic engineering, described his reaction as “shock and awe”. “I was shocked to receive the call letting me know I had won and I’m in awe of the prize,” he said. “Our work has been recognised because there are so many people using imaging devices in today’s world and they have had such a big social impact. Their quality exceeds anything we might have expected when we developed the first CCDs.”

Mr Fossum, professor of engineering at Dartmouth College in New Hampshire, said: “I didn’t imagine that I might win the world’s top prize in technology.”

Digital imaging sensors have made possible fast and cheap colour imaging at a resolution and sensitivity exceeding that of the human eye. They offer instant access to images ranging from microscopic cell structures to galaxies billions of light years away, transforming medicine and science as well as communications and entertainment.



Pioneers: Willard Boyle, left, and George Smith at Bell Labs in 1974 © DPA/Alamy

Lord Browne of Madingley, former BP chief executive and chairman of the QE prize foundation, announced the winners at the Royal Academy of Engineering in London. “The four engineers have revolutionised the way we capture and analyse visual information,” he said.

The imaging revolution began in the 1970s at Bell Labs in New Jersey, the corporate laboratory of AT&T, where George Smith and the late Willard Boyle invented the CCD as a new type of computer memory. Then their colleague Michael Tompsett discovered how to use the CCD for

imaging, converting photons (light particles) into electrical signals that could be stored as digital data.

When Mr Smith and Mr Boyle won the 2009 Nobel physics prize for inventing CCDs, Mr Tompsett was controversially excluded. “George Smith was never involved in the invention or development of the imager but he is part of this QE prize and that’s fine,” Mr Tompsett said.

In the 1980s, Professor Teranishi invented the pinned photodiode (PPD) at NEC in Japan, reducing the size of light-capturing ‘pixels’ and improving image quality. Then in the 1990s, Prof Fossum and colleagues at Nasa’s Jet Propulsion Lab in California developed CMOS technology, originally to make more compact and reliable cameras for spacecraft. That led to “camera on a chip” technology in the 21st century.

Prof Fossum promises more improvement to come. His team at Dartmouth is working on a “quanta image sensor” that would record every incoming photon. “We could have as many as a billion pixels on a chip,” he says. That would vastly improve the performance of digital cameras.

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