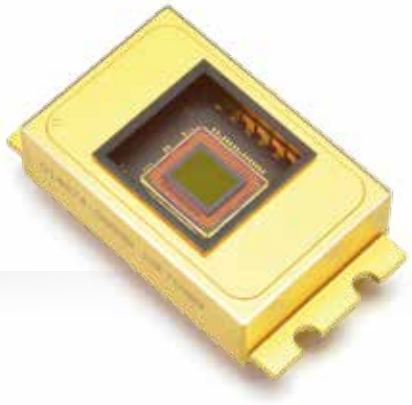


InGaAs area image sensor for hyperspectral cameras

Changing the Recycling of Plastic

Infrared image sensor capable of detecting up to 2.55 µm (world's longest*)

* InGaAs area image sensors (according to our research)

In May 2019, an amendment to the Basal Convention concerning regulations on the transporting and treatment of toxic waste across national borders was passed by an agreement among around 180 countries.

The main point of the agreement was to include the exporting and importing of plastic waste in the scope of the regulations. It drew a great deal of attention because the responsibility of developed countries, which relied on developing countries in the treatment of plastic waste, was made clear.

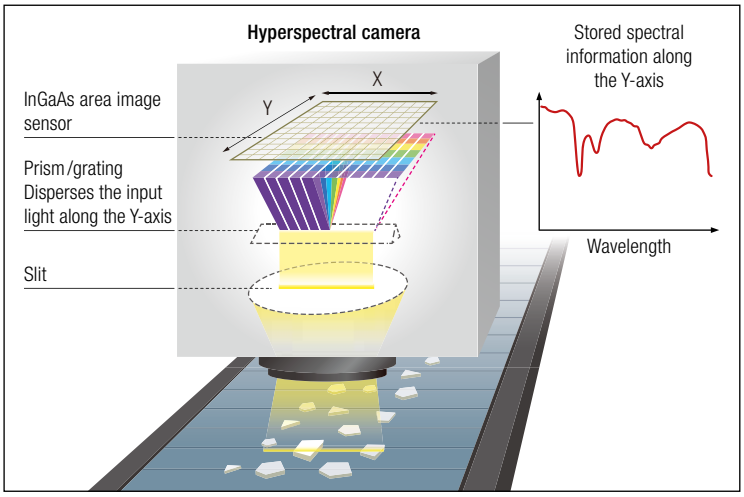
Reduction of plastic waste is a pressing issue for the entire human race. Hamamatsu infrared image sensors will be at the forefront of tackling this issue.

Hyperspectral imaging that improves the "screening accuracy" of plastic

In addition to China (last year's largest recipient) banning the reception of plastic waste, the enactment of a regulation on exporting recycle resources to developing countries has increased the importance of recycling plastic waste.

The key to effective plastic recycling is the identification of materials. Currently, a lot of the plastic waste is cut into little pieces with a shredder and then separated by materials. The screening method for this process that is receiving a lot of attention recently is "hyperspectral imaging", which distinguishes differences in plastics using infrared light. Hyperspectral imaging is a method by which pixel-level spectrum information is acquired simultaneously with the image of the target object. It is a useful method to identify and classify materials that are difficult to distinguish by eyesight. A hyperspectral camera is used to acquire hyperspectral images. Like normal line cameras, scanning is performed by moving the target object (or camera). The input light passes through a slit, is dispersed along the Y-axis direction by a prism/grating, and is measured by an area image sensor. Because a unique spectrum can be obtained in the infrared wavelength range, depending on the plastic material, using a hyperspectral camera with a built-in infrared area image sensor allows highly accurate identification.

Principle



CURRENT PRODUCT G13393-0808W 228 fps max.

NEW G14674-0808W 507 fps max.

Detecting infrared light up to 2.55 µm allows identification of plastics coated with flame-retardant resin

Hamamatsu has so far been producing InGaAs area image sensors that can detect infrared light up to 1.7 µm, but in this spectral range, identification of plastic that includes flame-retardant resin was difficult. Therefore, there were demands for sensors that could detect wavelengths up to about 2.4 µm, which exhibit differences in spectrum waveforms depending on the presence/absence of flame-retardant resin. To meet these market demands, Hamamatsu developed and released the G14674-0808W featuring a cutoff wavelength of 2.55 µm, which is the world's longest in InGaAs area image sensors. In addition to making the InGaAs photodiode capable of handling longer wavelengths, the readout circuit was also improved to achieve lower dark current and higher speed. The integration of this product into a hyperspectral camera expands the range of recyclable materials that can be screened and encourages recycling rate improvement.

Main features

Cutoff wavelength: 2.55 µm

Hamamatsu has successfully reduced the amount of defects that occur in the photosensitive area by optimizing the composition ratio of InAs and GaAs in the InGaAs photosensitive area and improving the process used to produce the photosensitive area. As a result, we were able to realize InGaAs area image sensors that can detect infrared light up to 2.55 µm. The product lineup also includes 1.69/1.85/2.15 µm cutoff wavelength types.

High-speed readout

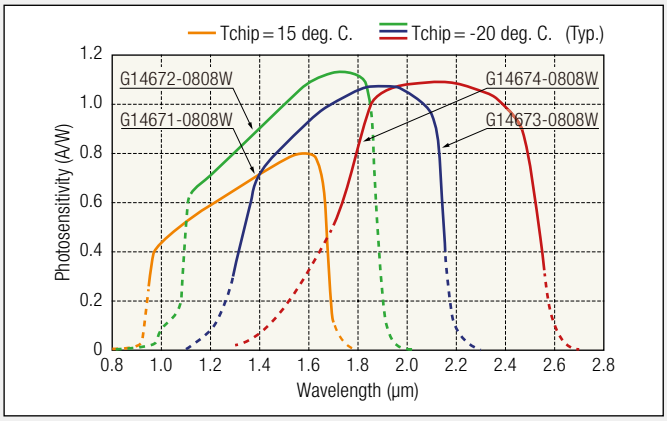
Narrower transistor gate length was achieved by designing and manufacturing original optimized circuits (ROIC*) in Hamamatsu. We were able to shorten the electrical signal transmission path. As a result, a frame rate of 507 fps max., which is more than double that of the current product, was achieved.

*Readout Integrated Circuit

Low dark current

An improved circuit that brings the voltage difference applied across the anode and cathode of the photosensitive area closer to zero was adopted to reduce the dark current that occurs in the photosensitive area.

Spectral response



Additional applications expected with the capability of handling longer wavelengths

Hyperspectral imaging is used in food, pharmaceutical, chemical, and various other fields, not just in the identification of plastic. The possibilities are limitless. With the development of image sensors capable of handling longer wavelengths, there is growing expectations for this technique to be used in applications such as the degradation diagnosis of concrete structures and identification of tablets, which were difficult in the past. Hamamatsu will continue to pursue the development of long-wavelength detection and develop products that meet customer needs.

Example of plastic screening by hyperspectral imaging