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Benefits of Using LEDs

Main advantages of mid-IR LED in comparison with infrared heating sources are:

1. **Fast response** (nanoseconds - in heating sources seconds or milliseconds), so they can be modulated, can work in pulse regimes. This is very important advantage if Customer amplify signal from infrared detector synchronized with the LED modulation or LED pulses for receiving maximum signal to noise ratio.
2. **Low electric power consumption, especially in pulse regimes.** Customer can use 200 ns pulses and can obtain during the pulse peak optical power more then 60-100 mW (for LED16-LED23). In LEDs you use all radiation because they have narrow spectrum (practically the same width as absorption band of the gas). In heating IR sources you have very wide spectrum and cut with filters only small part of it, so you don't use the most part of heating radiation.
3. **Small size.** Size of the LED chips is only 0.3x0.3 mm or 0.5x0.5 mm. We can mount many LED chips in one package, or on any surface that is useful for the customer, so optical cell (even for 2-3 or more gases) can be few millimeters. It is not possible with infrared heating sources due to their bigger size, filters and therefore due to high heat dissipation.
4. **Much longer lifetime.** As usual for LEDs lifetime is 50000-80000 hours, while for heating sources it is usually hundreds of hours.
5. In mass production self **cost of LEDs can be lower** then self cost of heating sources because you don't need filters or other optical elements. Cost of semiconductor chips reduce very strongly with increasing volume (up to 100 times) while cost of optical and mechanical elements can be reduced only on percents.

LEDs compared to other sources of infrared radiation

In thermal (heating) emission source of infrared radiation a wire is heated up by a current flow and emits in a very wide range according to Planck's law. The required spectral range is obtained by using special optical filters. Sensors employing this type of radiation source have some certain drawbacks:



- High electrical power consumption and low efficiency. Filter cuts only small part of wide emitted spectral range.
- Low speed of response.
- Heating infrared source practically can not be modulated by current.
- Short lifetime. Frequent catastrophic degradation takes place.
- Restricted possibilities for miniaturization due to high heat dissipation and necessity for using filters.

LEDs and Photodiodes that cover 1600-5000nm spectral range were developed and their production was started at IBSG. New Mid-Infrared LEDs possess certain advantages compared to heating infrared radiation sources:



- Compactness (size of the standard LED chip is 0.3x0.3 mm)
- Low electrical power consumption (down to 1 mW in pulse mode)
- High speed response (tens per nanoseconds)
- Long lifetime (up to 100 000 hours)
- Low cost in mass production

Creation of Mid-infrared optoelectronic devices became possible due to qualitative technological break-through in growing of latticed-matched heterostructures based on narrow band-gap substrates GaSb and InAs that was achieved last decade by IBSG Co., Ltd in collaboration with Ioffe Institute, Russian Academy of Sciences.