Uncooled detection in the middle- and long wavelength range of infrared spectrum and its applications

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Cryogenic cooling of detectors has always been the burden of sensitive infrared (IR) systems, particularly those operating in the middle (MWIR) and long wavelength (LWIR) range of infrared spectrum. Infrared detectors with limited cooling have obvious advantages including the elimination of power consuming cryogenics, reduction of size, weight, and cost, and the increase reliability. The number of applications potentially affected by near room temperature IR detector technology is widespread including the following military applications: head-mounted thermal imagers, missile seeker sensors, interceptor sensors, integrated modules for weapon sights, sniper and threat detection, wide area surveillance thermal imagers, handheld camera and weapons sights, driving sensors for unmanned vehicles, enhanced imagers for vehicle drivers, and eye-safe laser range finders. This technology has also widespread civilian applications such as: sensitive heterodyne detection, fast pyrometry, Fourier and laser spectrophotometry, imaging interferometry, laser technology and metrology, long wavelength optical communication, new types of gas analyzers, imaging spectrophotometers, non-destructive material testing and many others.
There have been many efforts to develop thermal and photodetectors that would not require cryogenic cooling. The importance of uncooled photo-detection of IR radiation was recognized in Poland very early where the first uncooled photodetectors of CO_2 laser 10.6 μm radiation were demonstrated in 1972. We present here the status of uncooled photodetectors developed and manufactured in Poland. The devices have been optimized for any wavelength within the 3 to 16 μm spectral range when operating at ambient temperature or with rugged Peltier coolers. Due to heterostructural design of active elements, optical immersion and other solutions the devices can obtain S/N performance close to the fundamental limits and sub-nanosecond response time. The devices have found numerous practical applications.