Near IR APD detectors. Application to high sensitivity direct detection DIAL. Johan Rothman, Kevin Foubert, CEA/LETI (France); Florian Le Mounier, Dimitri Edouart, LMD/CNRS (France); Claire Cénac, CNRS (France); and Fabien Gibert, LMD/CNRS (France)

ABSTRACT

A possible solution to the sensitivity issues in DIAL with lasers around 2 μm might be the advent of avalanche photodiodes made using the ternary alloy semiconductor HgCdTe. These devices are characterized by high linear avalanche gain, M>1000, absence of avalanche break down and an ultra-low excess noise, F=1.1-1.4. These characteristics are all consistent with a first demonstration of single carrier impact ionization multiplication in APDs made of HgCdTe. In addition, the detectors are have quantum efficiencies (QE) higher than 80 % for wavelengths from the visible range to the infrared cut-off wavelength HgCdTe, λc=2-5 μm depending on the Cd composition. The combination of low F and high QE makes the HgCdTe APDs the highest performing amplified photodetector in terms of information conservation, a property which opens a new horizon of possible application, in particular for IR application. The single carrier multiplication do also imply that the bandwidth in the APD is not directly dependent on the gain, leading to record high gain bandwidth products which opens new perspectives for application in telecom, Lidar and single photon detection.

In the present communication we will give a brief overview of the typically performance of HgCdTe APDs for single element applications such as direct detection Lidar. System design optimization will be discussed in terms of operating temperature, APD gain, active optical area and sensitivity. We will finally detail the expected performance of a detector under development at CEA/LETI for application in the DIAL system developed in LMD with help from the French space agency (CNES) R&T program and present first results obtained with an intermediate prototype.