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The first study of structural, electronic, optical and thermodynamic properties of $Hg_{0.8}Cd_{0.2}Te$ alloys

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Mercury cadmium telluride (HgCdTe) is the material system of choice to fabricate high performance photovoltaic and avalanche detectors over the entire infrared spectral region. Several groups have reported an exponential gain curve and extremely low multiplication noise in electron injected HgCdTe avalanche photodetectors (APDs) at temperatures in the range of 77 K to 260 K for a variety of cutoff wavelengths in the MWIR and LWIR bands. These exceptional characteristics of HgCdTe APDs are indicative of the exclusive impact ionization of the electrons and of dead-space effects that tend to introduce order in the random impact ionization process, i.e., a history-dependent gain mechanism. The electron impact ionization process in HgCdTe becomes important at relatively small electric fields due to the high mobility of electrons and their low impact ionization threshold energy. The high gain at low bias and the low noise factor make HgCdTe APDs particularly well suited for several applications, including night vision, nondestructive control and medical imaging, multicolor focal-plane arrays (FPAs) for astronomy, and photon counting. Despite this interest, a complete description of the transport properties of HgCdTe alloys is still lacking, especially in the high-field regime. The low field mobility has been the only transport parameter that has been the object of extensive theoretical [6] and experimental investigations. The electron drift velocity characteristic in CdTe as a function of temperature and electric field was measured by the transient-charge technique by Canali Borsari and coworkers performed Monte Carlo calculations of electron transport in CdTe to investigate the negative differential mobility of this material, which was attributed to the randomizing effect of intervalley scattering rather than to the population of lower-mobility valleys.

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