Modeling of LWIR HgCdTe Infrared Detectors Under Non-Equilibrium Operation

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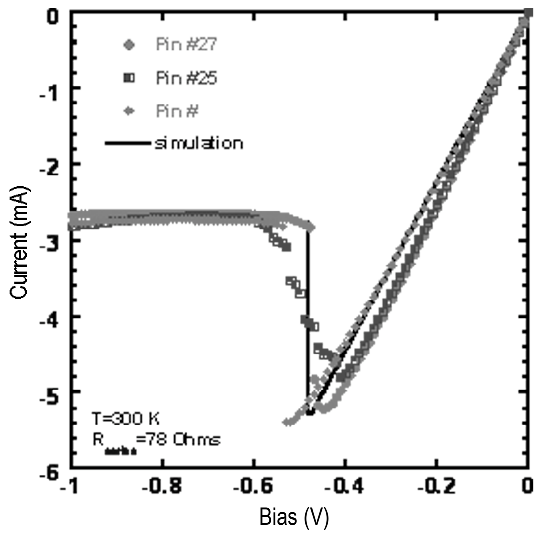
A nearly universal goal for infrared photon detection systems is to increase their operating temperature without sacrificing performance. For HgCdTe infrared detectors at elevated temperatures, the carrier density in the low-doped absorber region is high due to the thermal generation of intrinsic carriers. The high-carrier density in the absorber region will result in a high-photodiode dark current which is typically dominated by Auger processes. Device designs with a combination of exclusion and extraction junctions under reverse bias have been proposed to suppress Auger processes in the absorber. This device design reduces dark currents in comparison to standard p-n junction photodiodes, offering the potential to achieve background limited performance at significantly higher temperatures. In collaboration with EPIR Technologies and the U.S. Army Research Laboratory, we reported pronounced Auger suppression at 300K in LWIR HgCdTe detectors grown by MBE. We also used a numerical model solving Poisson and electron and hole continuity equations to simulate these devices and fit the experimental I-V characteristics. This numerical analysis validated pronounced Auger suppression characterized by a sharp decrease of the dark current beyond ~0.5V reverse bias. We also performed a current and lifetime analysis in order to examine improvements and limitations of these devices. This project was supported by MDA under contract number HQ0006-05-C-0006.



Reverse bias dark I-V measured at T=300 K for three selected devices, along with the simulated fitting curve (solid line).