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GaAs Based High-Power Photodiodes for Advanced LIGO

LIGO-G020370-00-Z

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Harris Group Solid State Lab

Photodiode Specifications

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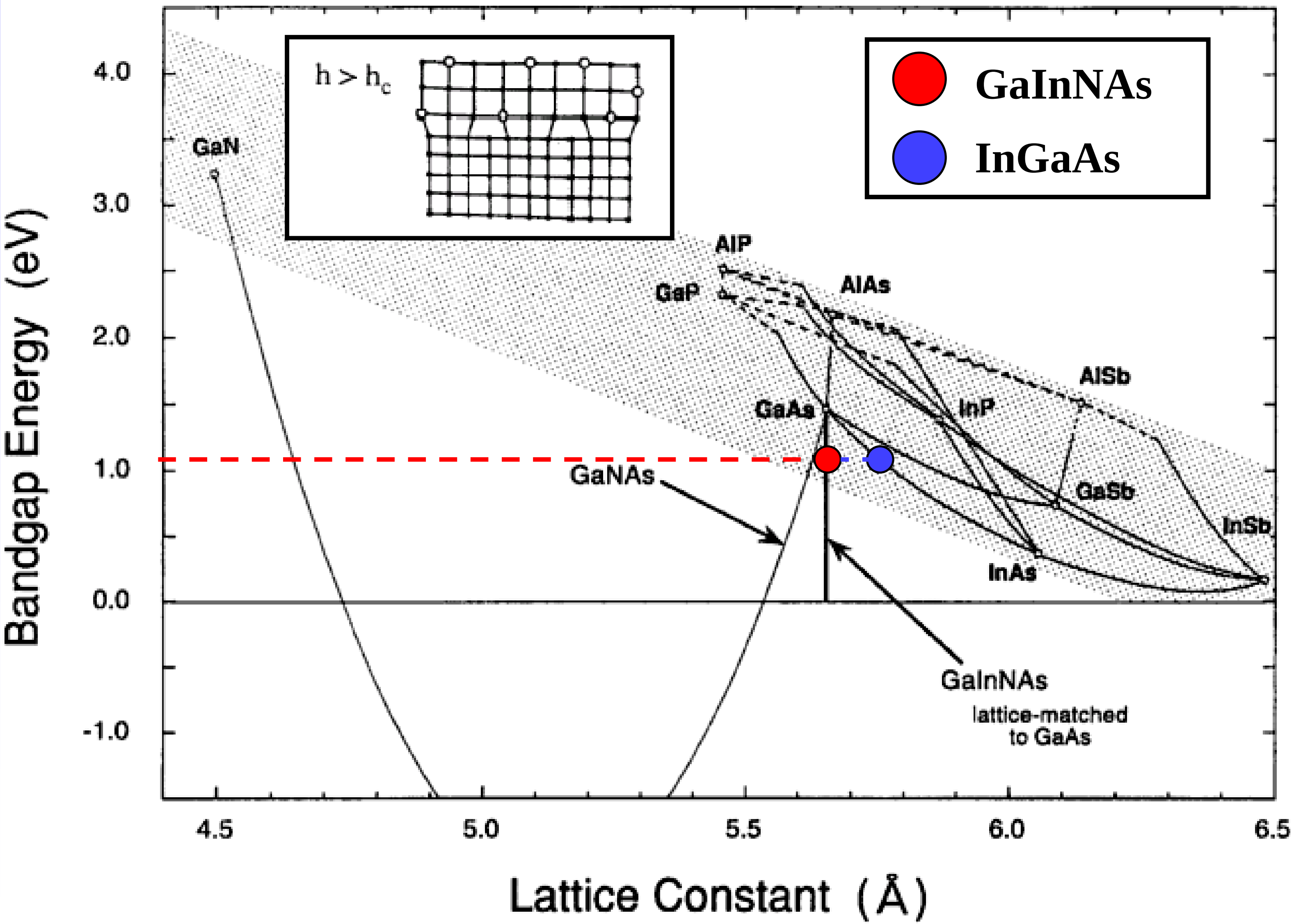
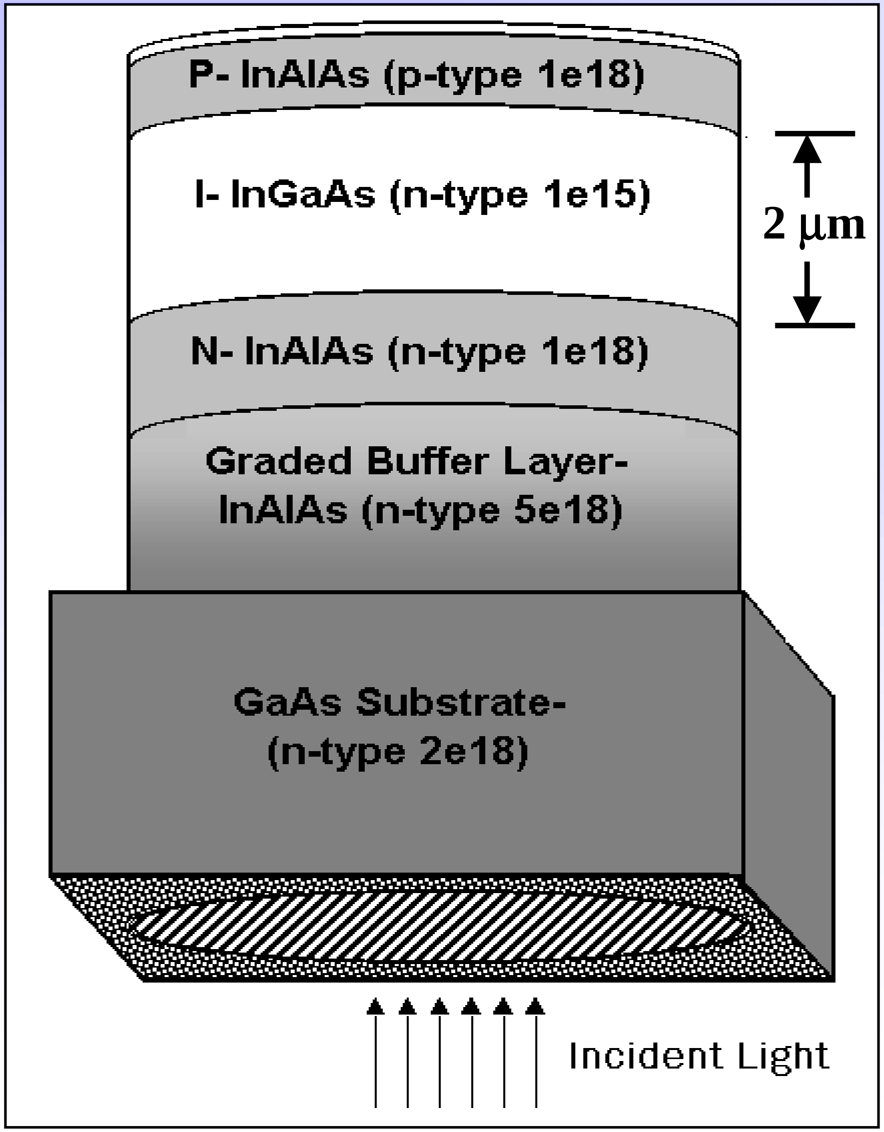
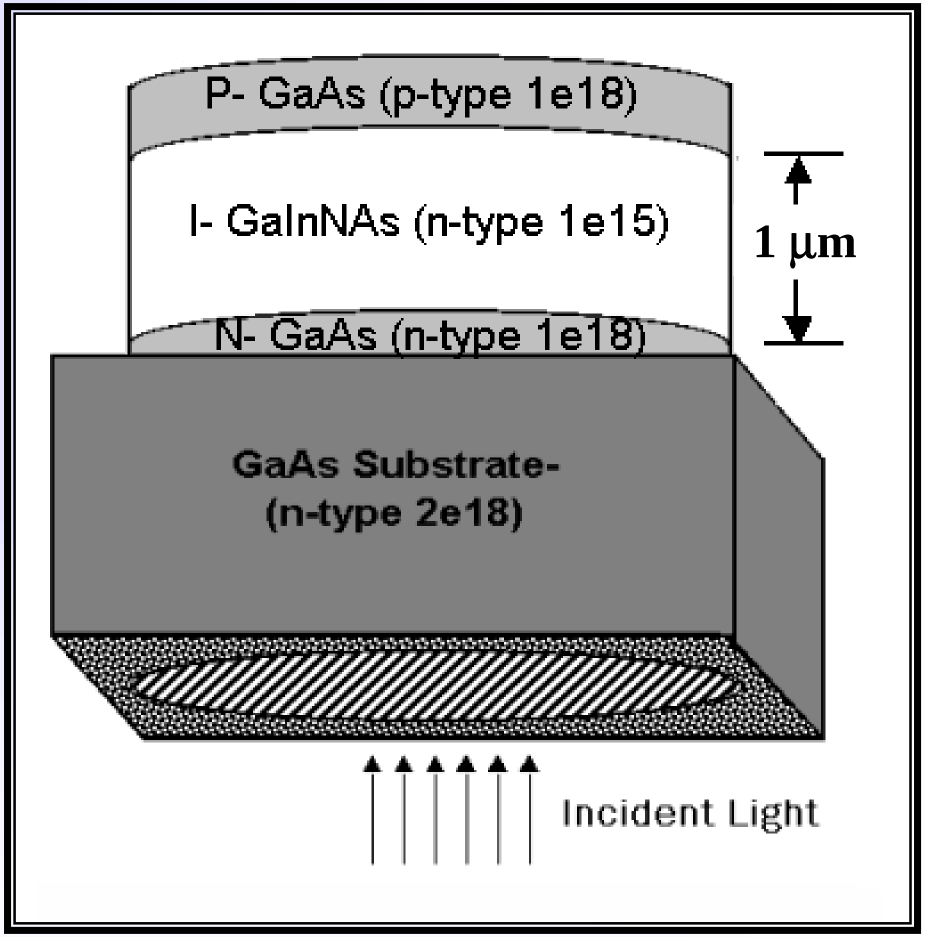
Parameter	LIGO I	Advanced LIGO
Steady-State Power	0.6 W	~1 W
Modulation Frequency	< 29 MHz	100 kHz ~ 180 MHz
Quantum Efficiency	> 80%	> 90%
Laser Wavelength	1064nm	1064nm
Detector Design	Bank of 6(+) PDs	1 PD

InGaAs vs. GaInNAs



InGaAs vs. GaInNAs PD Designs





GaInNAs lattice-matched to GaAs!

Rear-Illuminated PD Advantages

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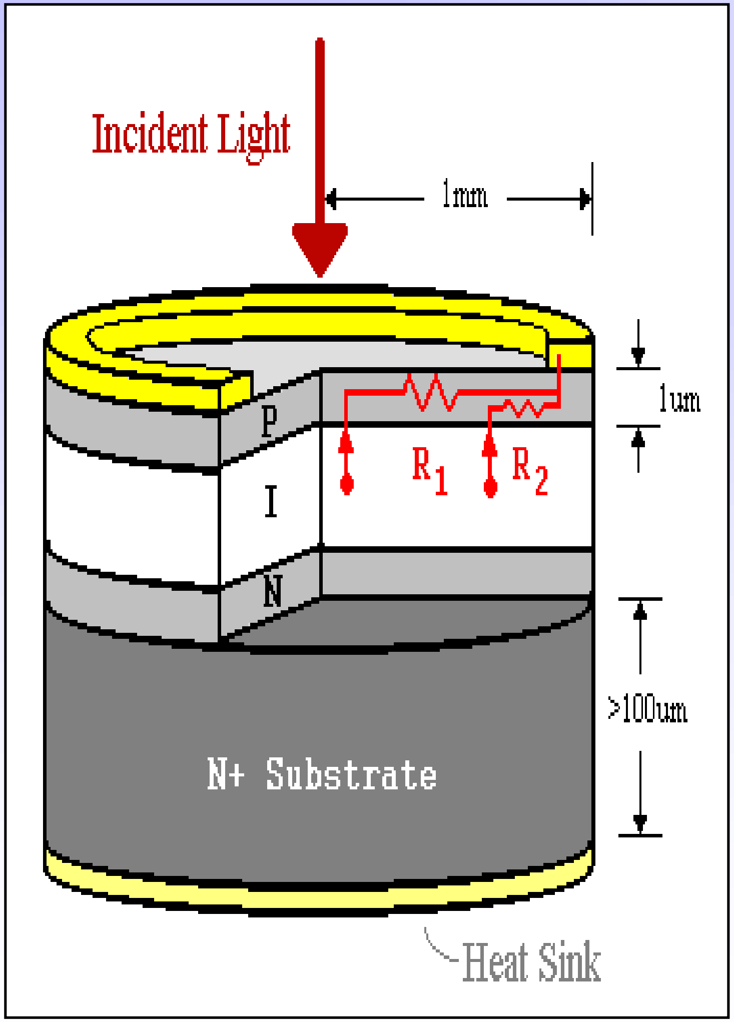
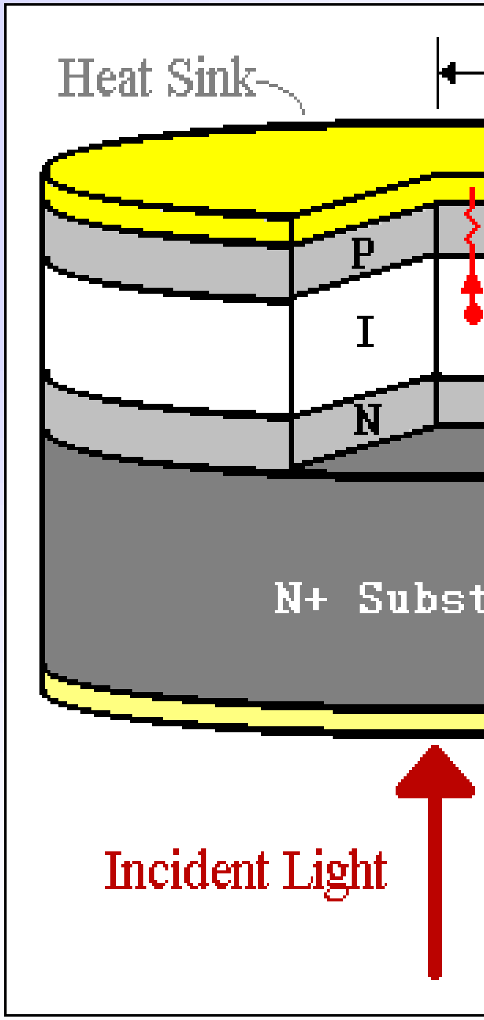


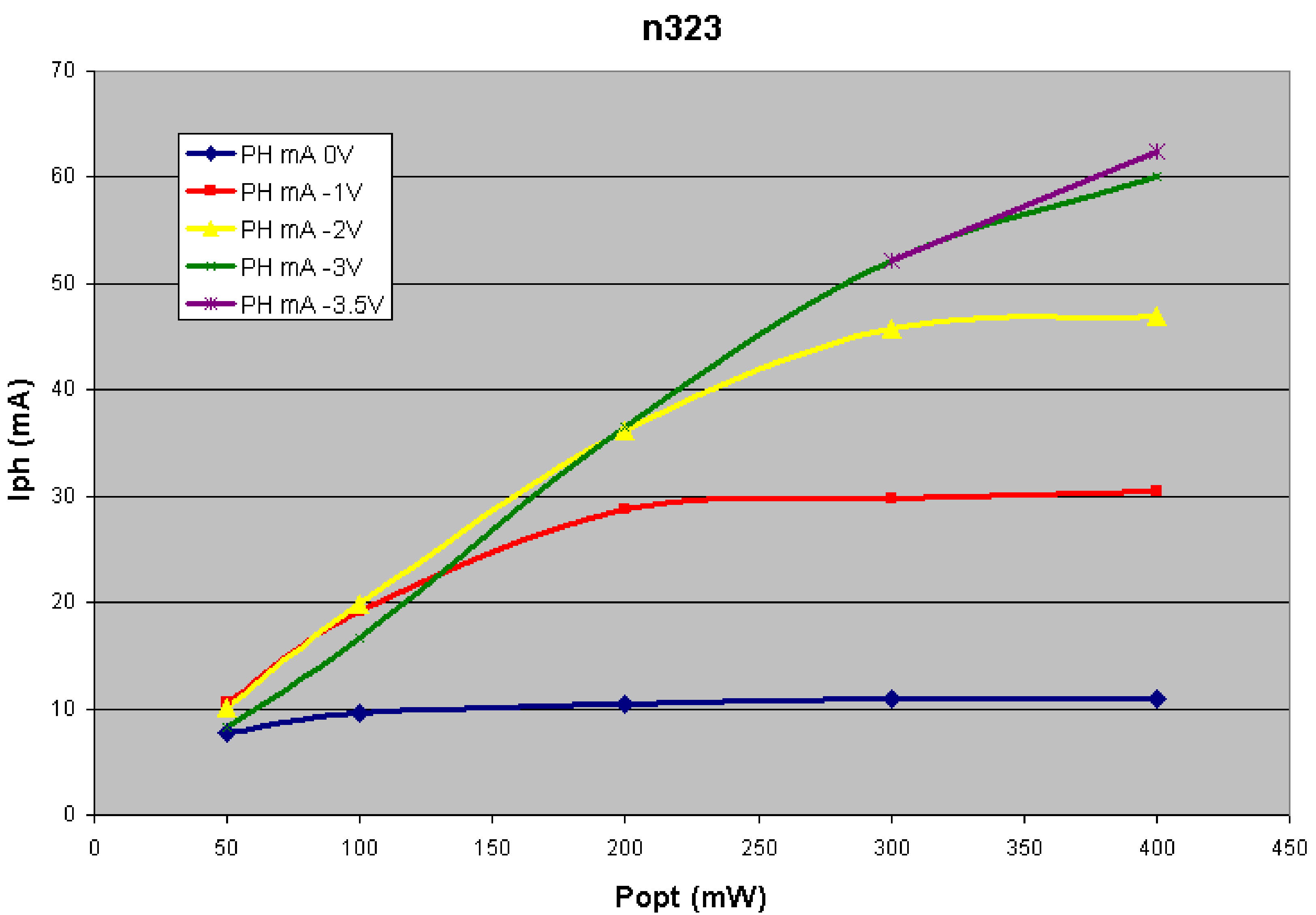


- High Power
- Linear Response
- High Speed

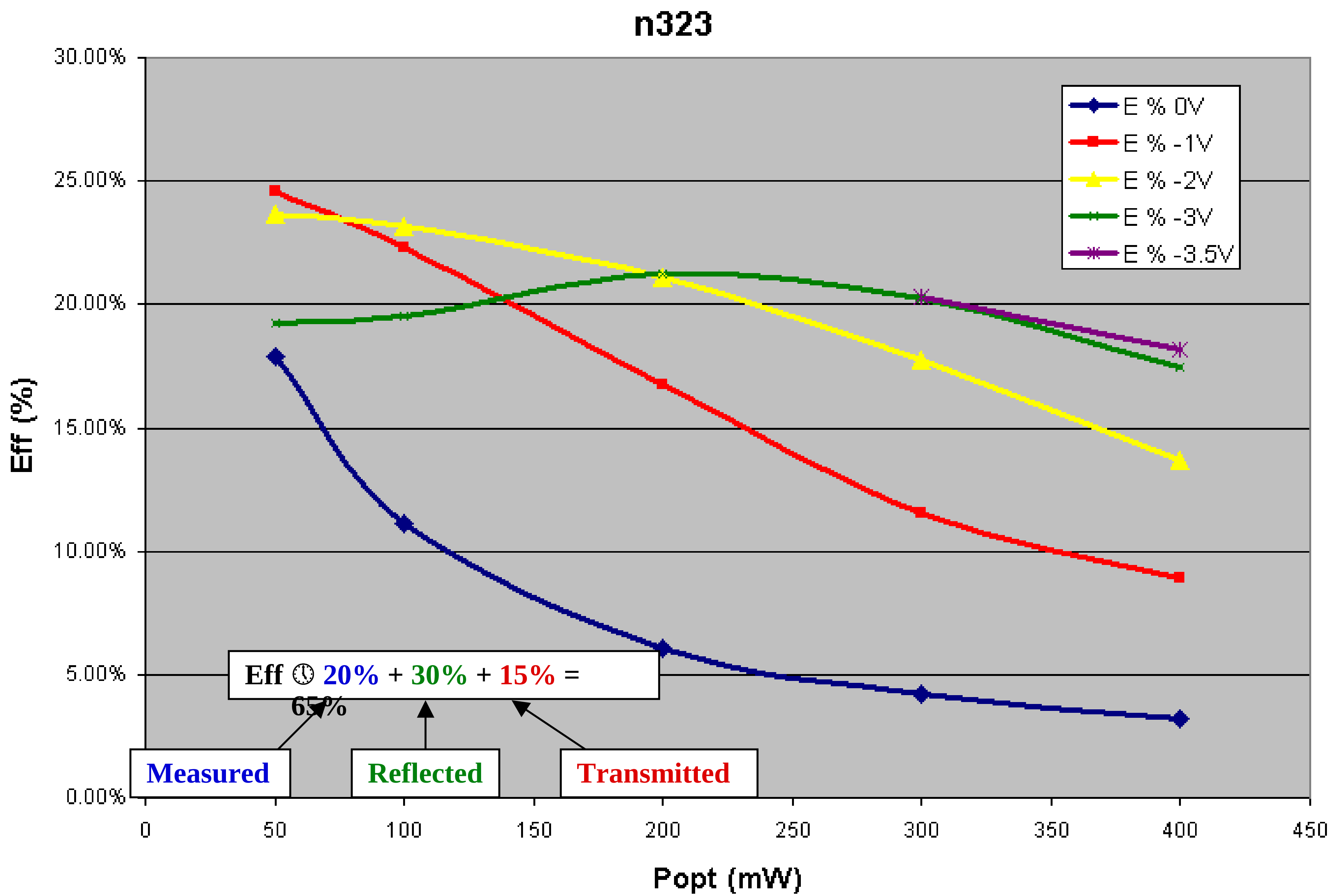
Conventional PD

Adv. LIGO Rear-Illuminated PD

GaInNAs Photodiode Linearity



GaInNAs PD Efficiency



InGaAs PD: Dark Current

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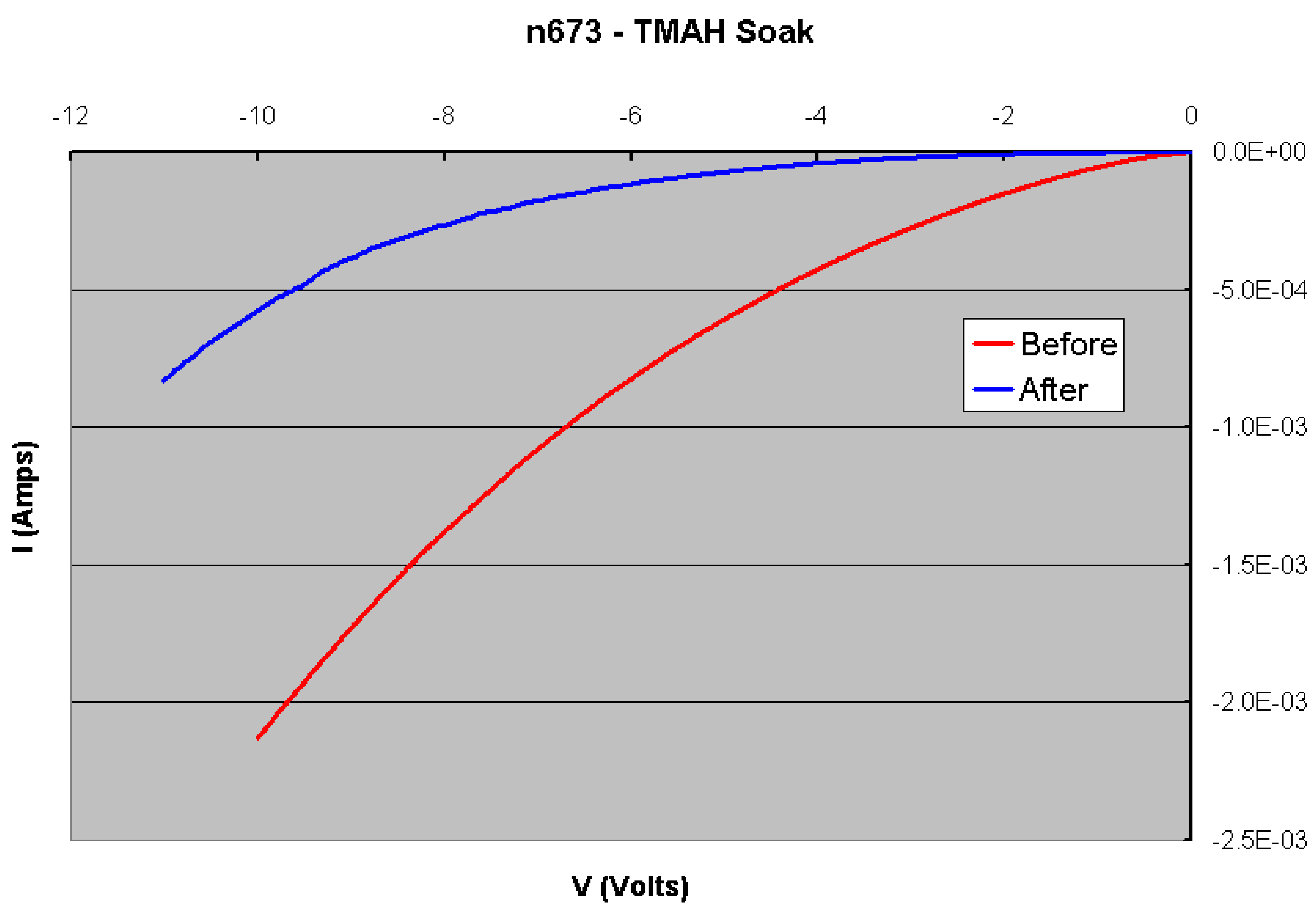

Junction "Passivation"

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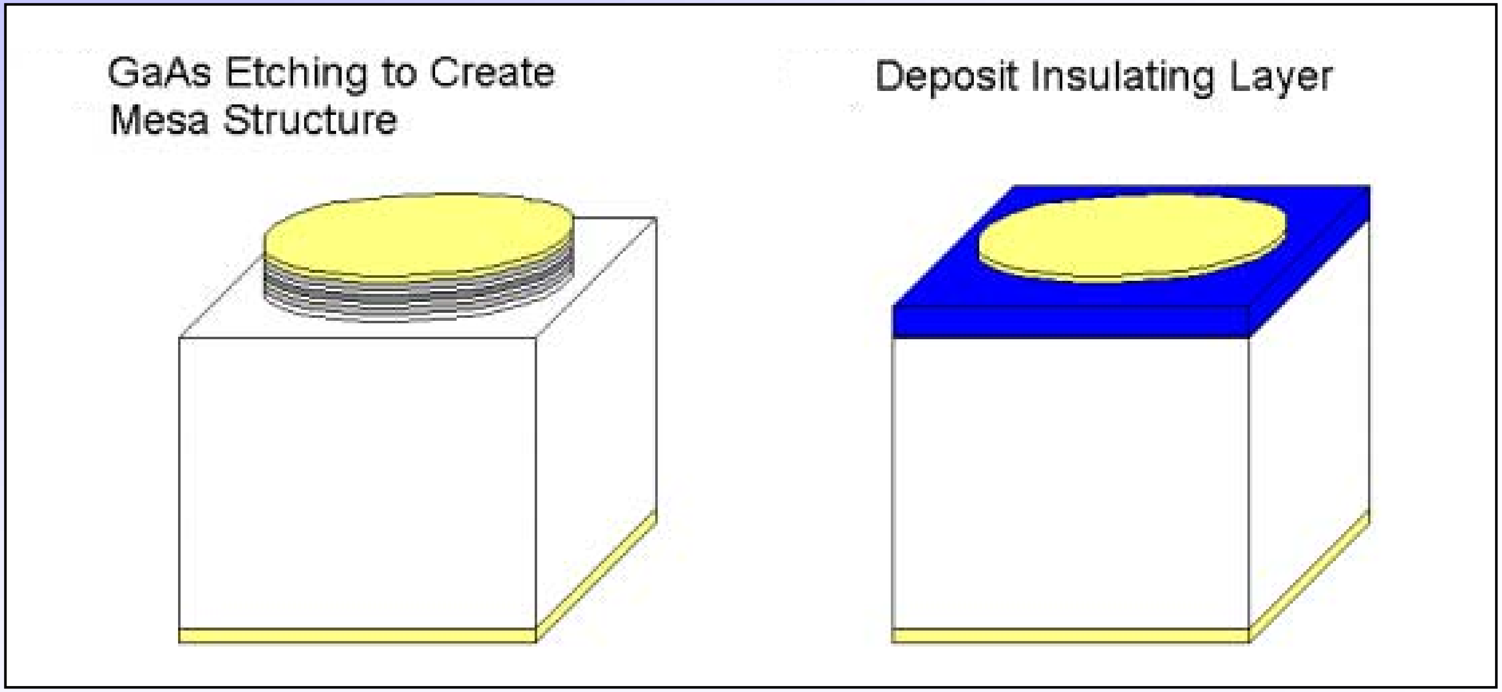

Plasma Etching

→ **Ar, BCl_3, Cl_2**

Polyimide Spinning

→ **Cresol-novolak Resin (AZ 9260 PR)**

InGaAs: Polyimide “Passivated”

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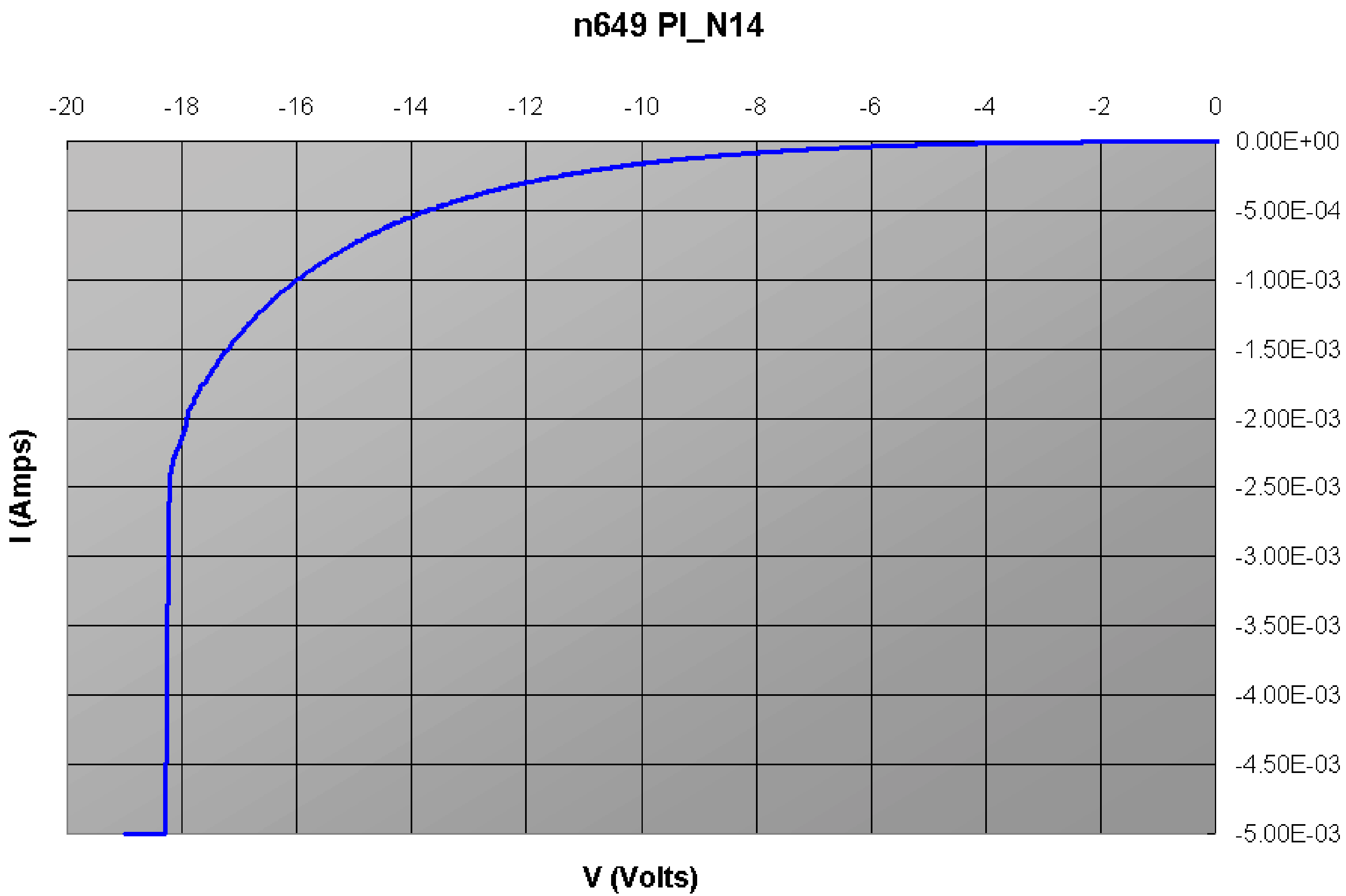

Future Work

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- GaInNAs
  - 2-micron I-Layer
  - Etching and Passivating
- InGaAs
  - Thinned Substrate
  - Etching and Passivating
- RF Setup
  - High Power Voltage Source