Characteristics of InP Particles Detectors Structures

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Outline

- motivation
- initial substrate
- structures
- technology
- results
- conclusions

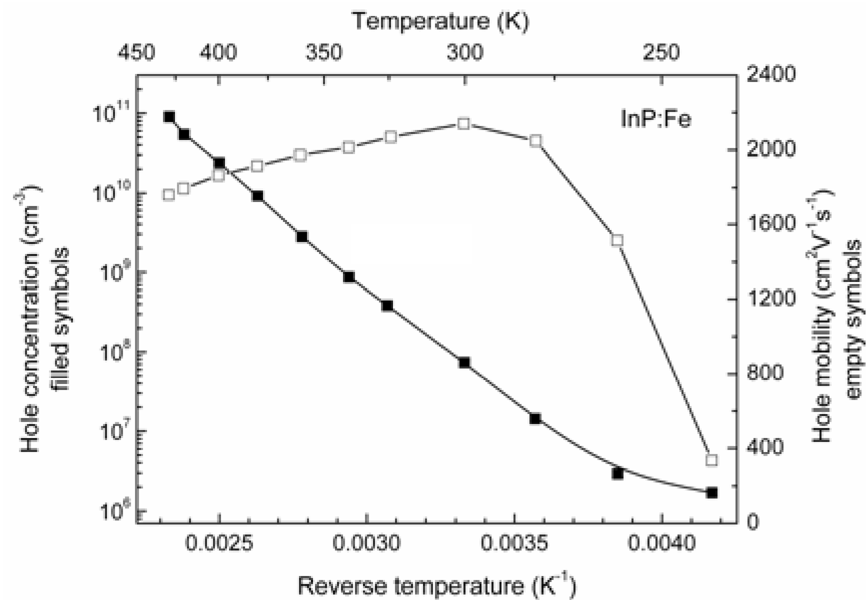
Motivation

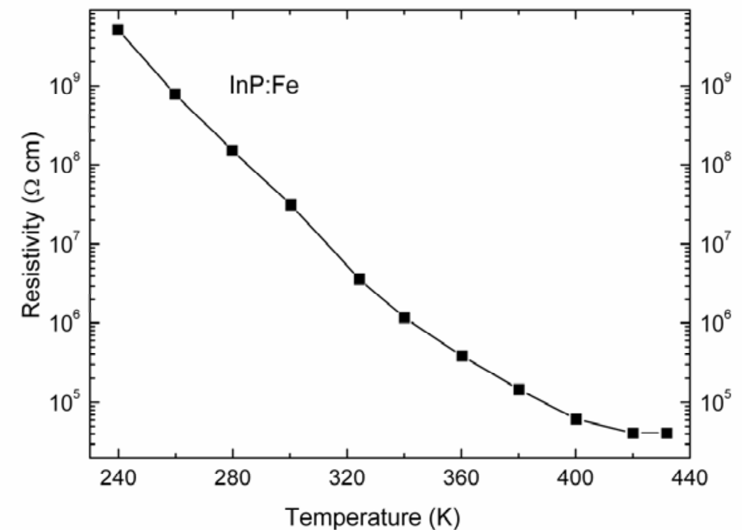
Physical parameters of most used semiconductors at 300 K

Material	Atomic number	Density g/cm^3	Band-gap eV	Dielectric constant	Ionisation energy, eV	Resistivity Ohm.cm	Mobility cm^2/V.s		$\mu\tau$ product cm^2/V	
							e	h	e	h
Si	14	2.33	1.12	11.7	3.62	$\approx 10^4$	1400	480	>1	≈1
Ge	32	5.33	0.67	16	2.96	50	3900	1900	>1	>1
CdTe	48,52	6.2	1.44	11	4.43	10^9	1100	100	3.3×10^{-3}	2×10^{-4}
GaAs	31,33	5.32	1.43	12.8	4.2	10^7	8000	400	8×10^{-5}	4×10^{-6}
InP	**49,15**	**4.78**	**1.35**	**12.5**	**4.2**	10^7	**4600**	**150**	**4.8×10^{-6}**	**$<1.5\times10^{-5}$**

Initial substrate InP

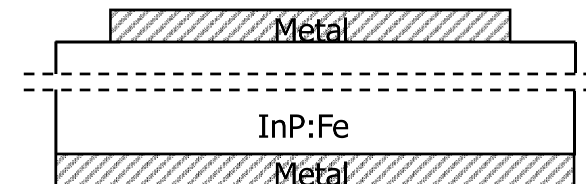
- SI InP : Fe , (100) n – type,
- binding energy 0,64 eV



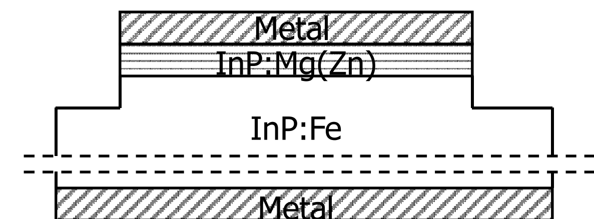


InP detector structures

- Schottky junction

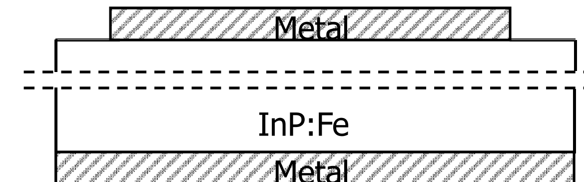


- Epilayer junction



Technology of Schottky barrier

- Contact metal
  (6 nm Ni, 60 nm AuGe,
  30 nm Ni, 200 nm Au)
  annealing in nitrogen,
  2 min. at 400°C
- Schottky junction
  $\phi = 2$ mm
  (same material
  not annealed)

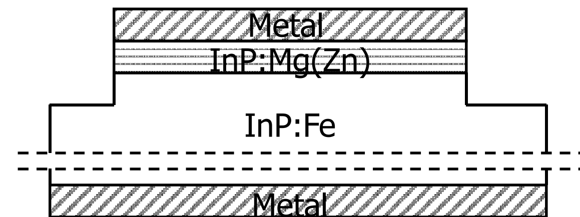


Epilayer junction technology

Liquid phase epitaxy technique
- epilayer of thickness 1 um

Dopant Mg: $2,1.10^{17} cm^{-3}$

MESA etch in $HBr:K_2Cr_2:H_2O$



Metal:

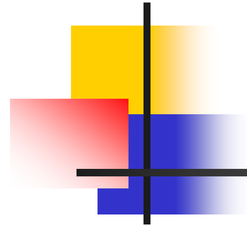
On P side:

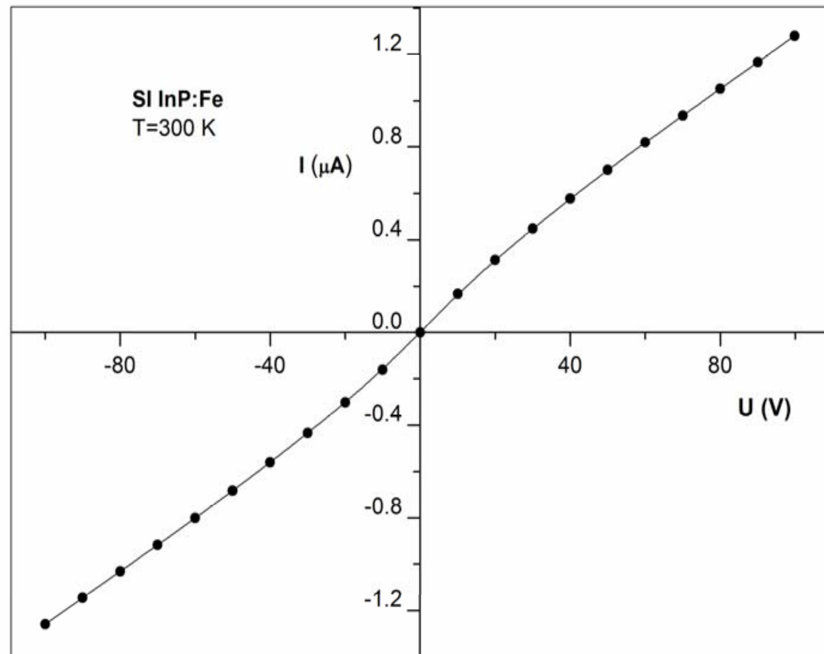
AuBe (25 nm)
Cr (50 nm)
Au (200 nm)

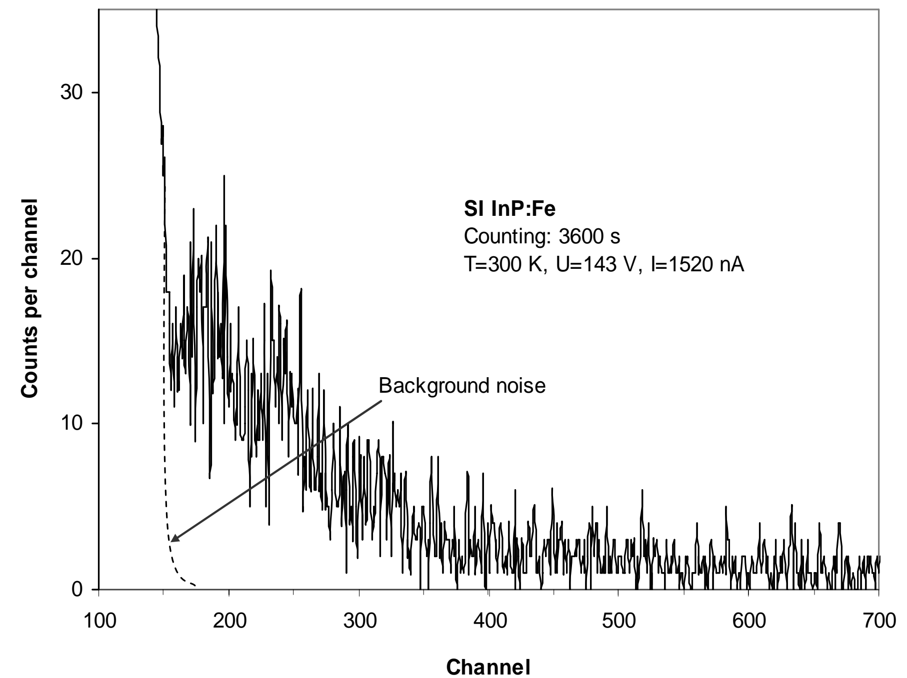
On N side:

Ni (6 nm)
AuGe (60 nm)
Ni (30 nm)
Au(200 nm)

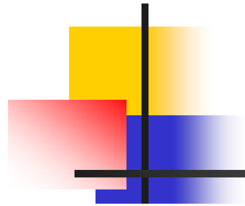
Detector on InP:Fe substrate Schottky (1)

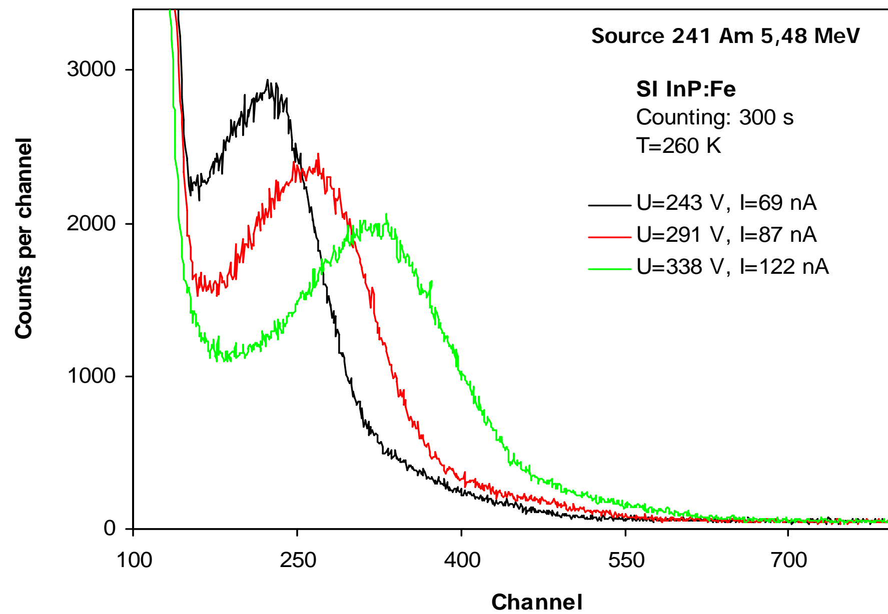


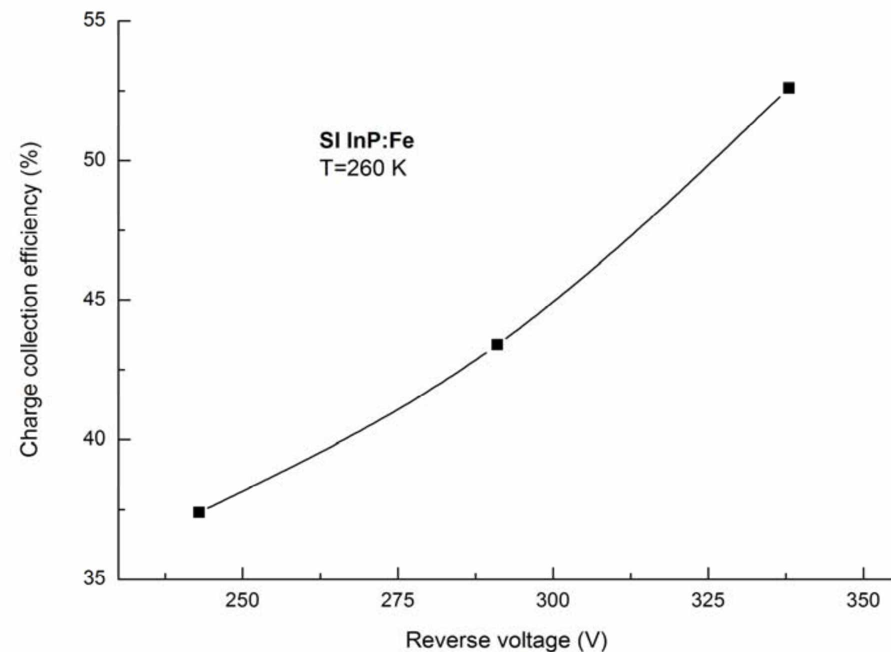




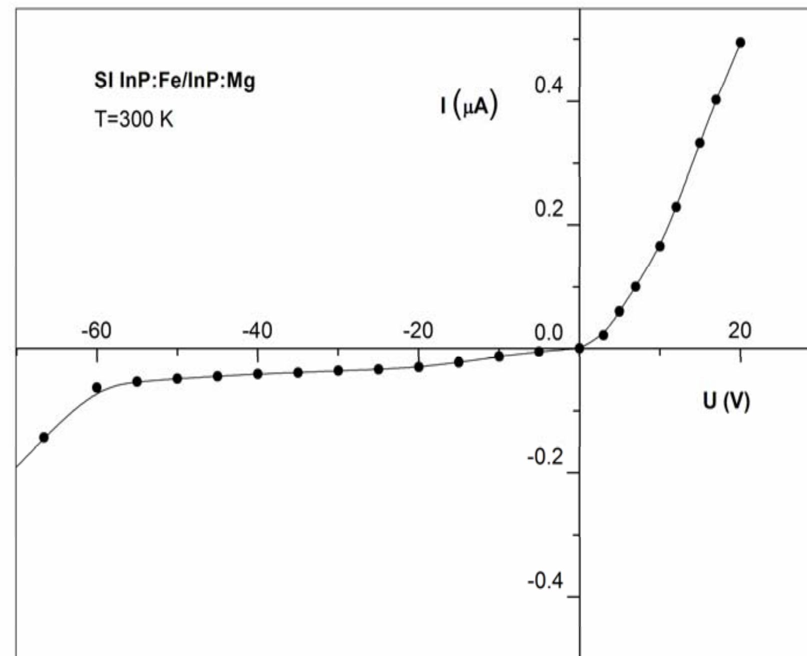
Detector on InP:Fe substrate Schottky (2)



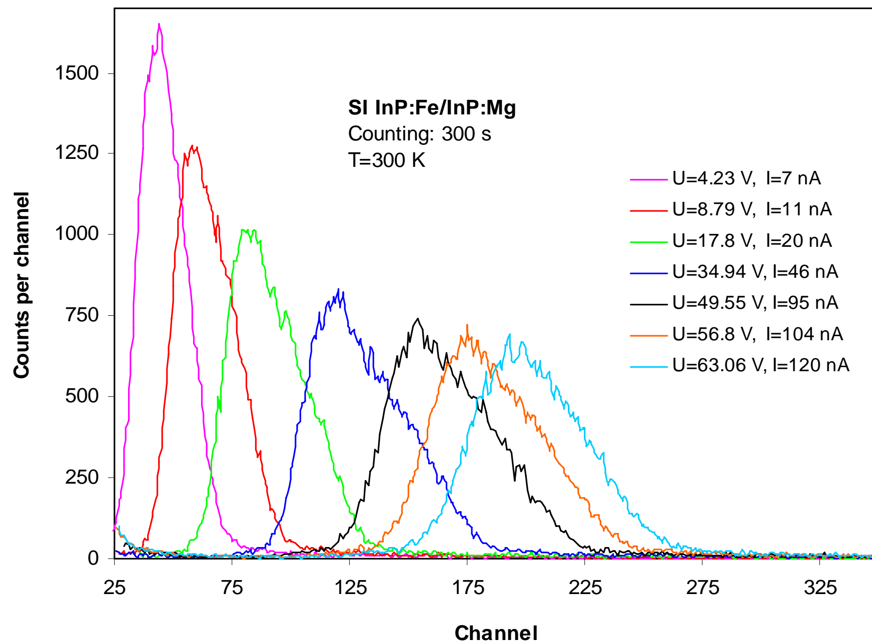


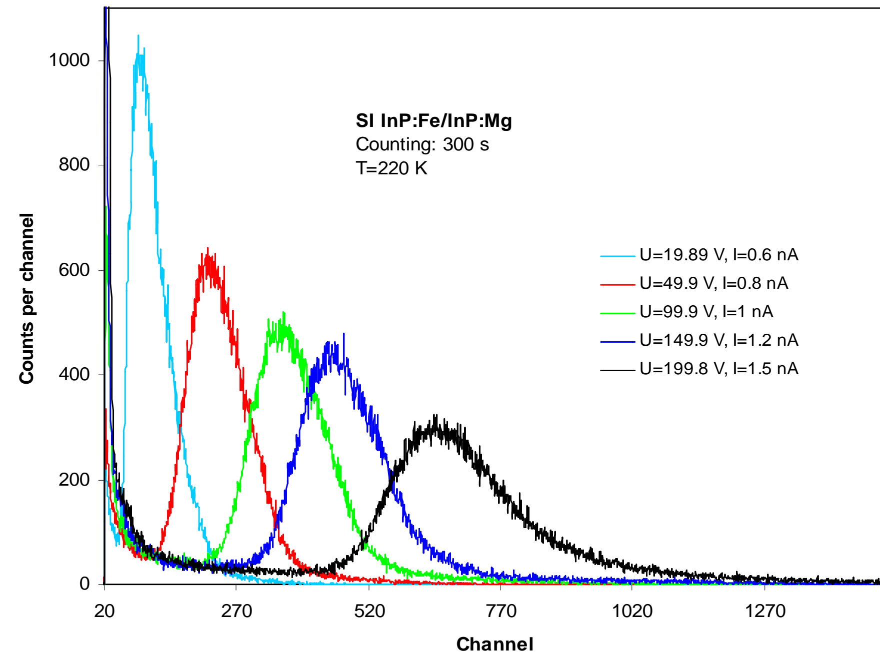


Detector on InP:Fe substrate epilayer junction (1) Mg, T=300 K

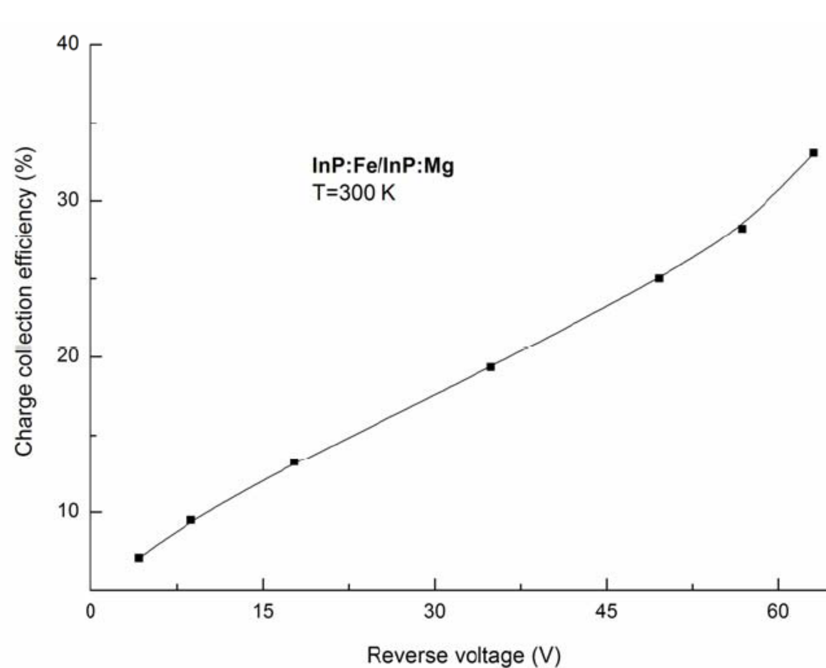


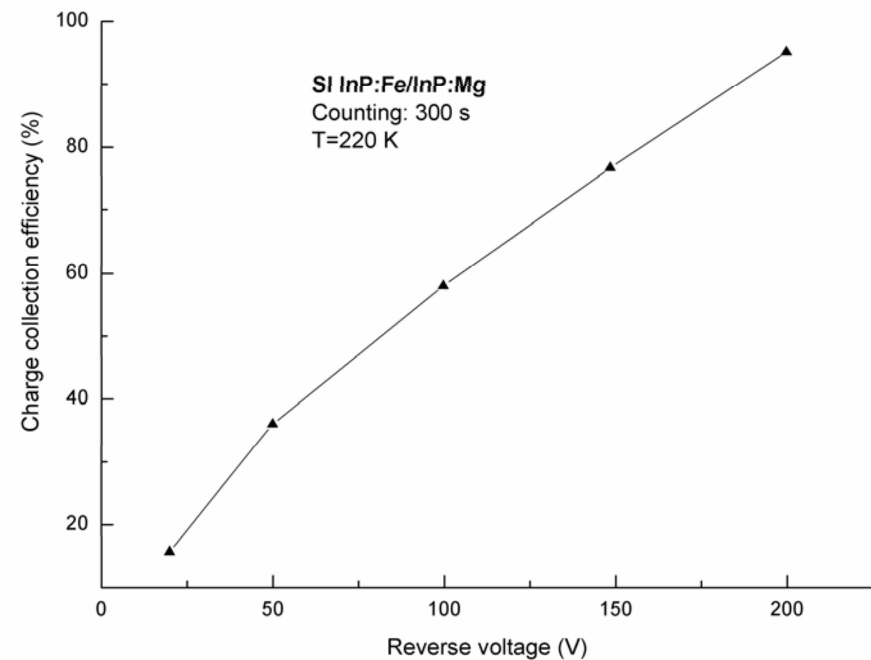
Detector on InP:Fe substrate epilayer junction (2) Mg





Detector on InP:Fe substrate epilayer junction (3) Mg, CCE





Conclusion

- technology of InP:Fe with epilayer InP:Mg was managed
- detectors produced with InP:Mg epilayer have better characteristics than InP:Fe Schottky diodes at 220 K
- InP:Mg epilayer structure operates at RT

Near Future Investigation

- standardization of horizontal structure and technology
- application of Be dopant
- study of radiation hardness