

TH02E-5

Optimization of Coplanar Waveguide Integrated PCM Switches

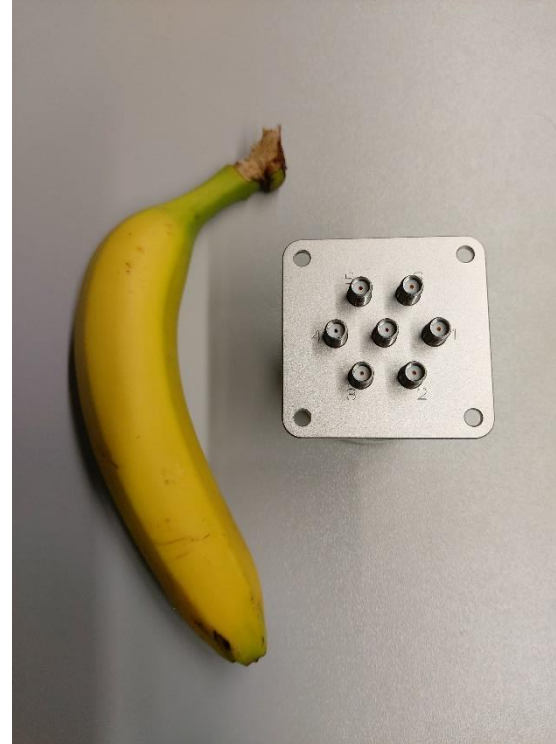
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C. Hallepee, D. Passerieux, P. Blondy
XLIM, University of Limoges, France



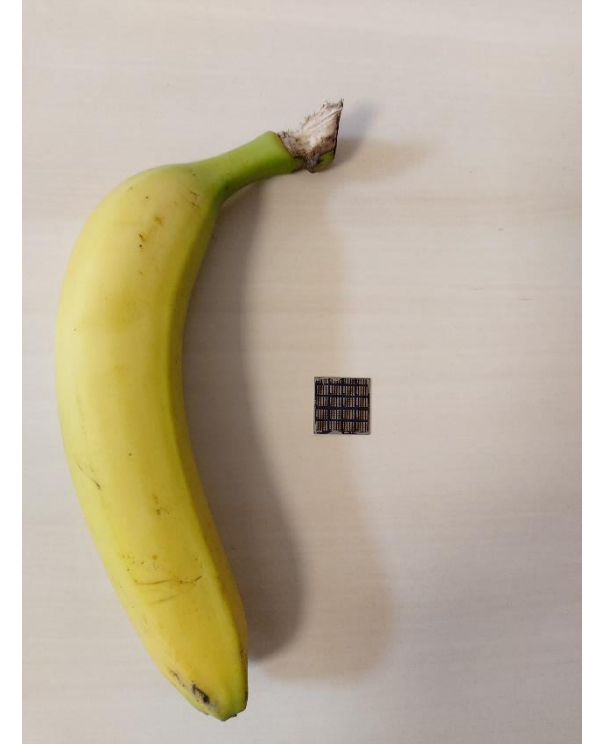
- **Introduction**
- **Phase-Change Material RF Switches**
- **1st Optimization of the Coplanar Waveguide**
- **2nd Optimization of the Coplanar Waveguide**
- **Conclusion**

Introduction

- Low insertion loss
- High isolation
- Bi-stability
- Endurance
- Compacity



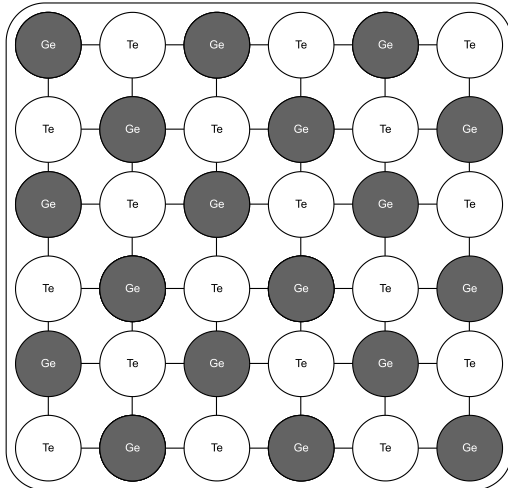
SP6T electromechanical
relay matrix



≈400 PCM switches SPST

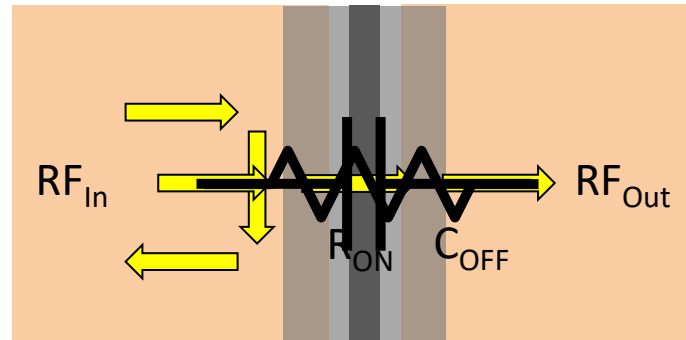
PCM RF Switches

Crystalline phase - GeTe

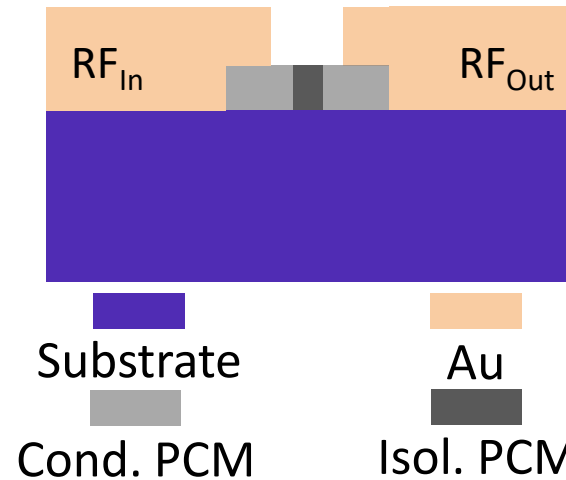


- High electrical conductivity
- Stable with no energy supply

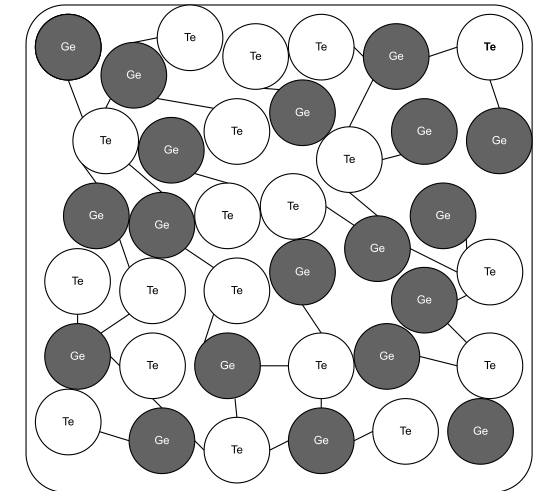
Top view of PCM switch core



$$R_{ON} \cdot C_{OFF} = FOM$$

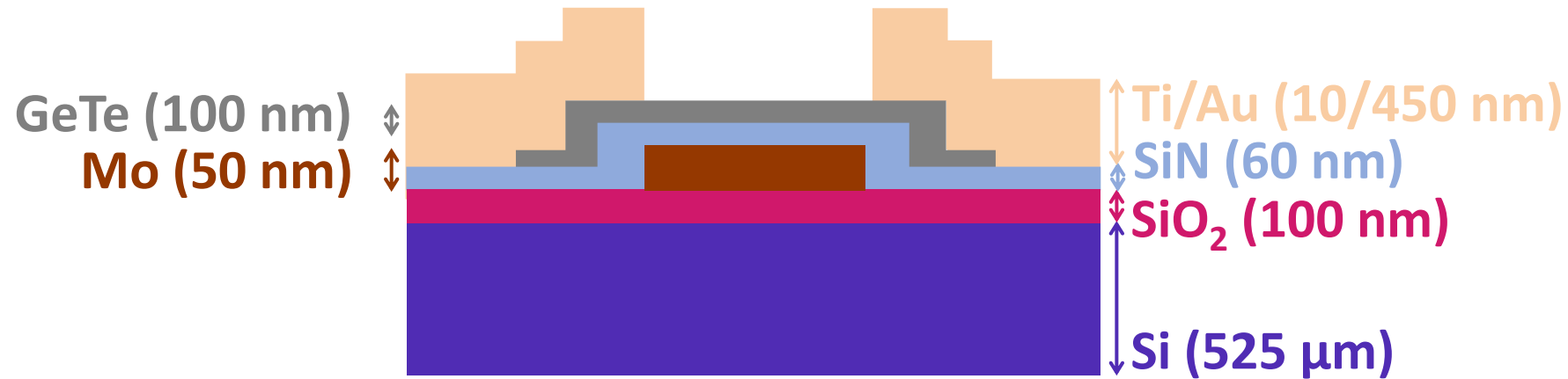


Amorphous phase - GeTe



- Very low electrical conductivity
- Stable with no energy supply

PCM RF Switches

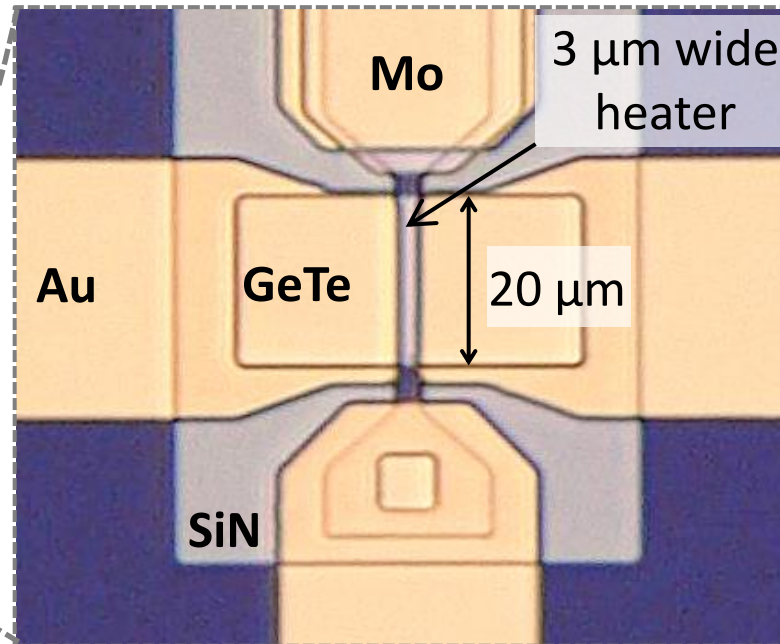
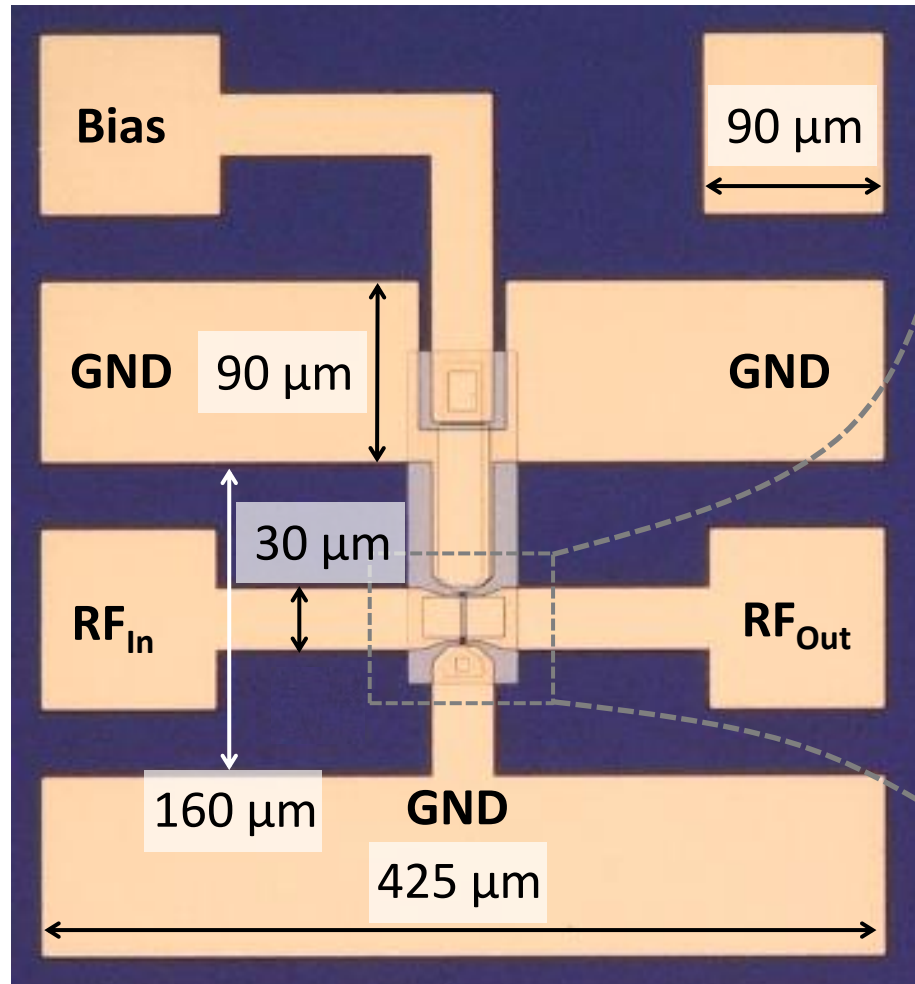


Cross sectionnall view

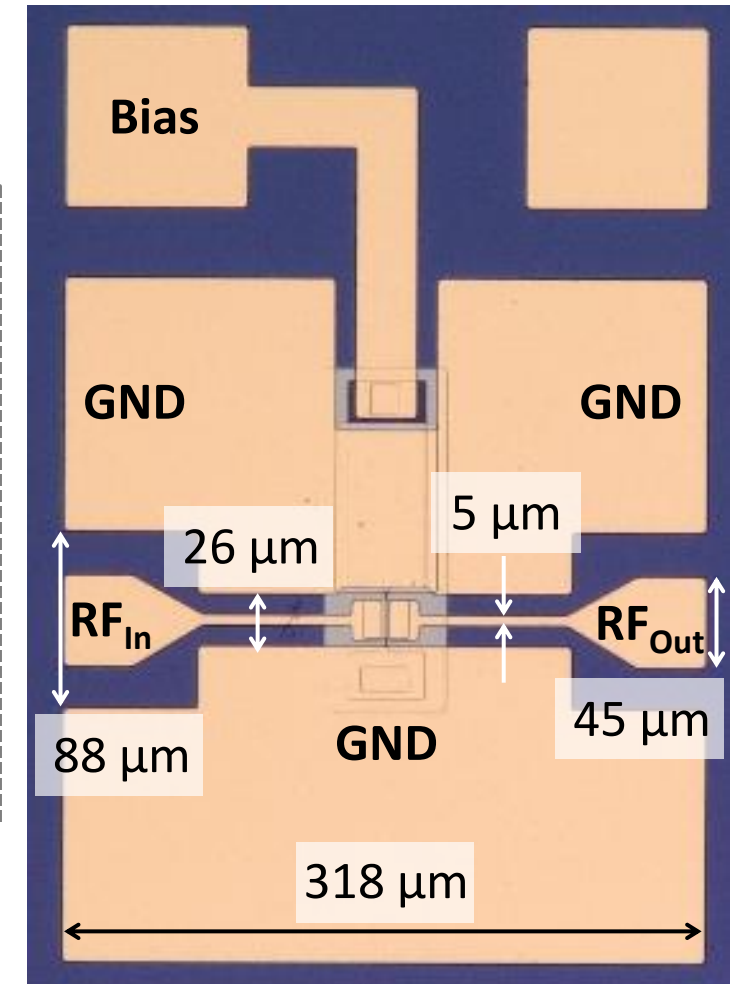
- 1) Mo: DC sputtered and wet etched → Heater element
- 2) Si₃N₄: PECVD and RIE etched → Dielectric shield between PCM and heater
- 3) GeTe: RF sputtered and RIE etched → PCM
- 4) Ti/Au: Evaporated and lifted off → Metallization

1st Optimization of the Coplanar Waveguide

Conventional design

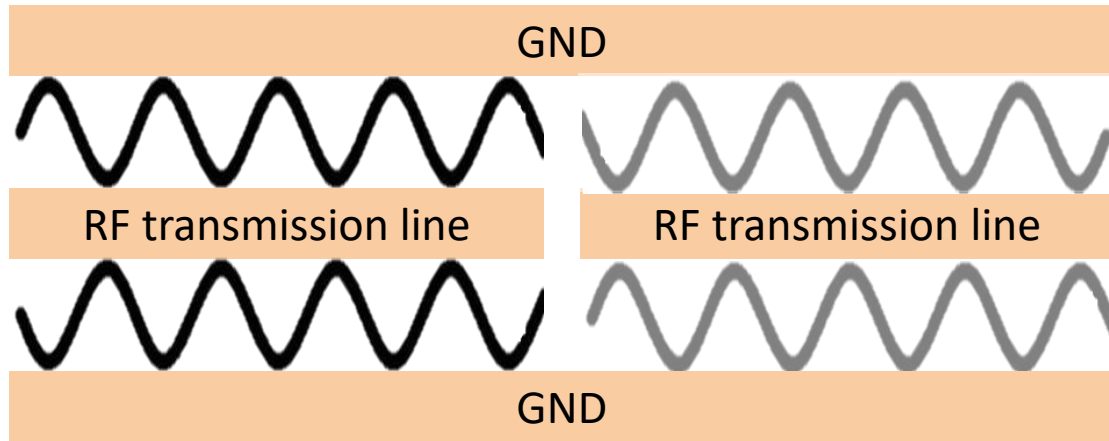


Optimized design v1

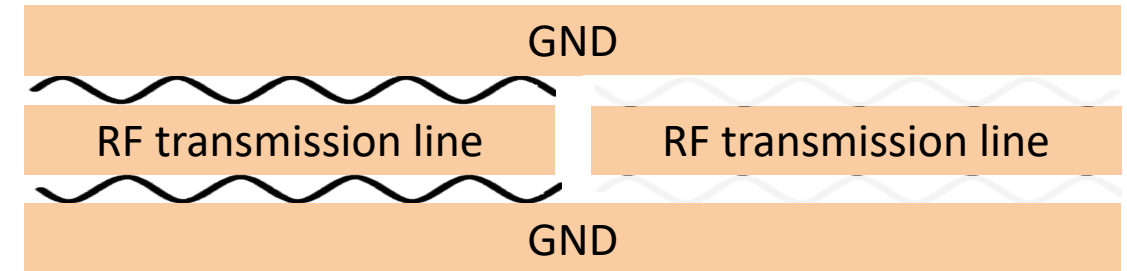


1st Optimization of the Coplanar Waveguide

Conventional design coplanar waveguide

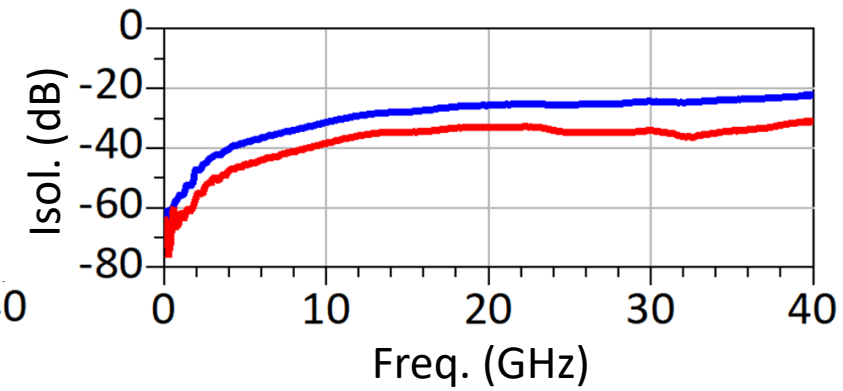
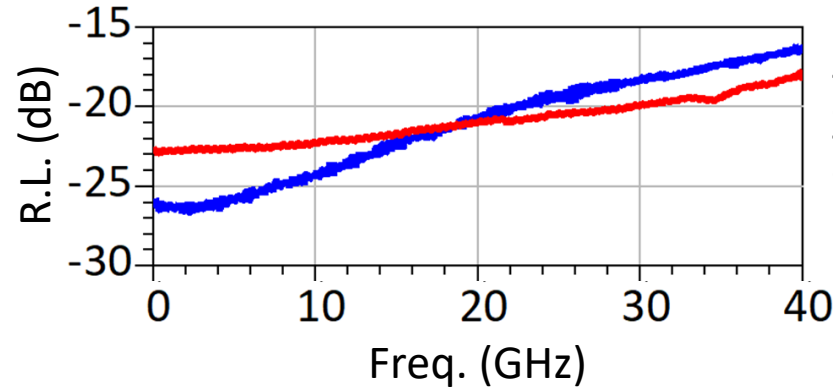
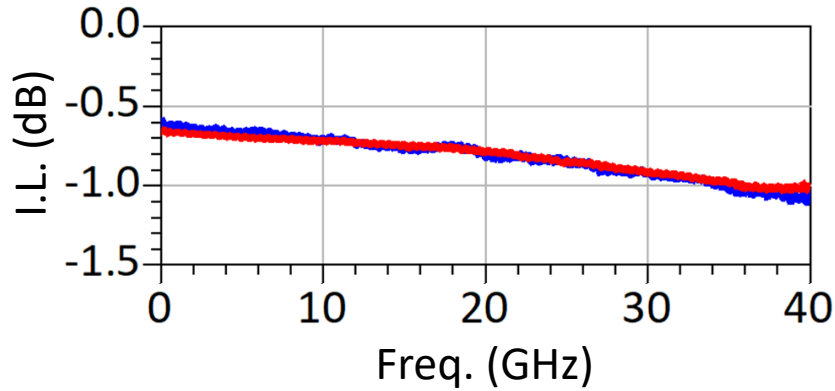


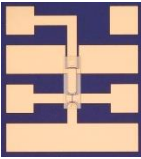

Optimized design coplanar waveguide



Gap appears longer for narrow ground-to-ground plane distances !

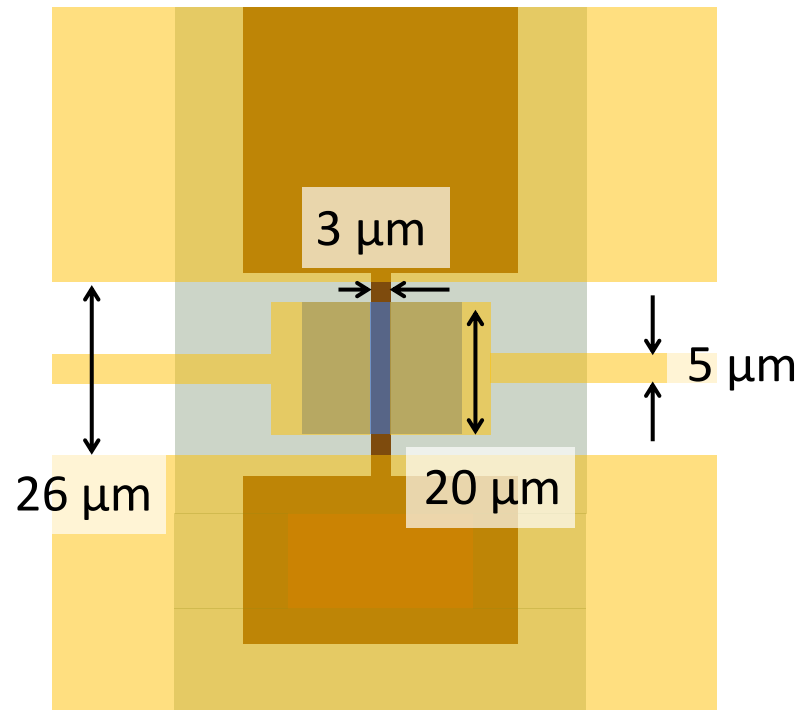
1st Optimization of the Coplanar Waveguide



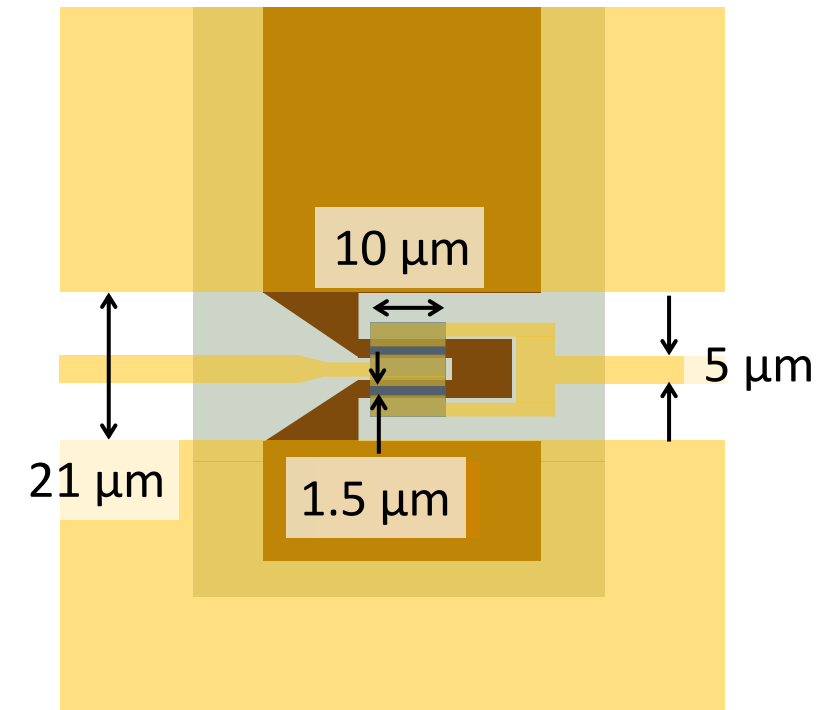
		Insertion Losses			Reflection Losses	Isolation		FOM
		$S_{21}@2\text{GHz}$	$S_{21}@40\text{GHz}$	$R_{\text{ON DEEMB}}$	$S_{11} @ 40 \text{ GHz}$	$S_{21}@40\text{GHz}$	C_{OFF}	$R_{\text{ON}} \cdot C_{\text{OFF}}$
Conventional design		-0.64 dB	-1.05 dB	4.8 Ω	-16.4 dB	-22.4 dB	3.1 fF	14.9 fsec
Optimized design v1		-0.67 dB	-1.0 dB	5.4 Ω	-17.9 dB	-31.1 dB	1.1 fF	5.9 fsec

2nd Optimization of the Coplanar Waveguide

Optimized design v1

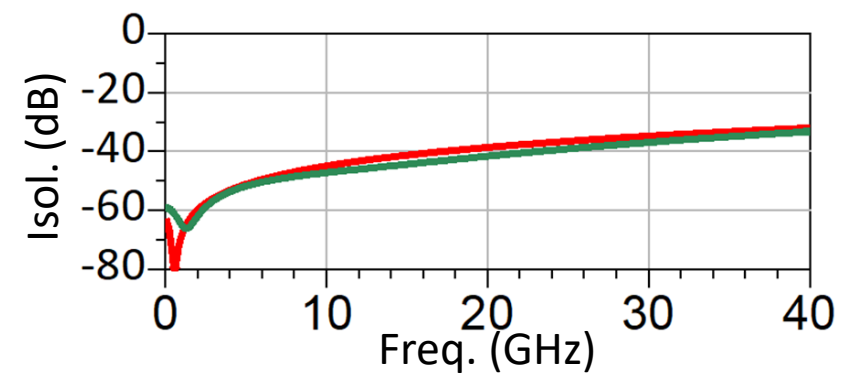
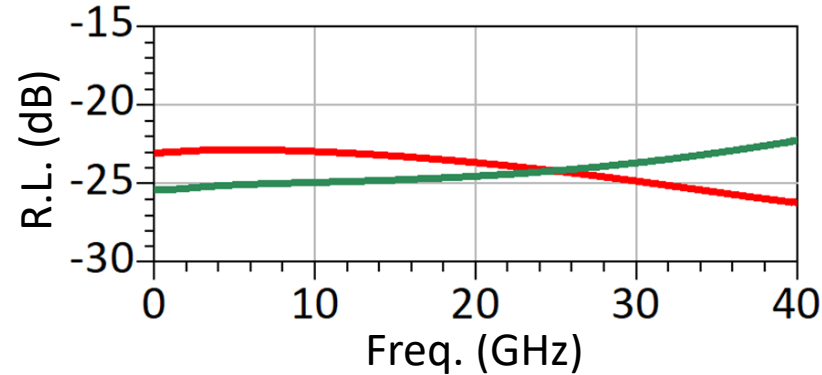
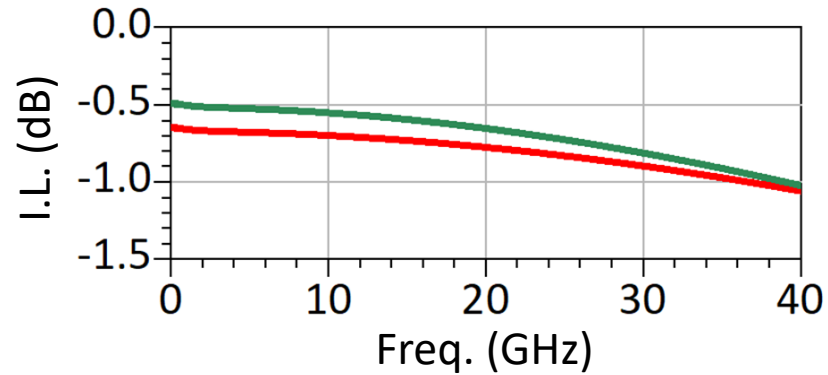




Optimized design v2



- Closer ground plane
- Narrower GeTe gap

2nd Optimization of the Coplanar Waveguide



		Insertion Losses			Reflection Losses	Isolation		FOM
		$S_{21}@2\text{GHz}$	$S_{21}@40\text{GHz}$	$R_{\text{ON DEEMB}}$	$S_{11} @ 40 \text{ GHz}$	$S_{21}@40\text{GHz}$	C_{OFF}	$R_{\text{ON}} \cdot C_{\text{OFF}}$
Optimized design v1		-0.67 dB	-1.06 dB	5.4 Ω	-26.2 dB	-31.1 dB	1.1 fF	5.9 fsec
Optimized design v2		-0.51 dB	-1.02 dB	3.4 Ω	-22.3 dB	-33.3 dB	0.86 fF	2.9 fsec

Conclusions

- Narrower ground-to-ground dramatically enhances isolation, with the same PCM switch core
- Low insertion loss
- High endurance
- High compacity
- Easily integrable in CMOS process

Acknowledgment

The authors would like to thank the DGA (French Ministry of Defense) and the National Research Agency under the ANR-10-LABX-0074-01 Sigma-LIM for institutional grants.

Thank you for your attention.

Do you have any questions ?

Annexe 1

