DATERAC

Development and applications of exploratory technologies for the reconfiguration of antennas and microwave devices

Erwan FOURN, Clément RAGUENES (IETR)
Denis LE BERRE, Rozenn ALLANIC, Youcef AMARA, Cédric QUENDO (Lab-STICC)
Other partners:
Cyril PARANTHOEN (institut FOTON)
Virginie NAZABAL, Albane BENARDAIS (ISCR)

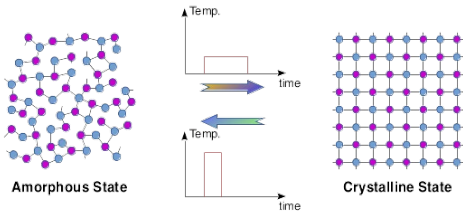
Introduction

- **Exploring 2 innovative techniques** to reconfigure microwave devices and antennas
  - ✓ Phase change materials (PCM) optically controlled
  - ✓ Semiconductor Distributed Doped Areas (ScDDAs) electronically controlled
- In the longer term, **combine both solutions** to multiply the possibilities!

Reconfiguration principles

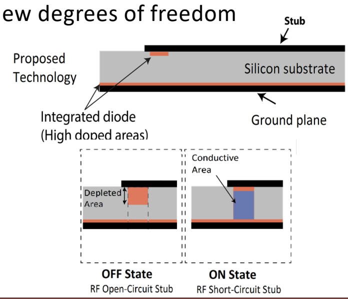
PCM

- Amorphous state => Low conductivity
- Crystalline state => High conductivity
- Conductivity ratio of 10^4 to 10^6



ScDDAs

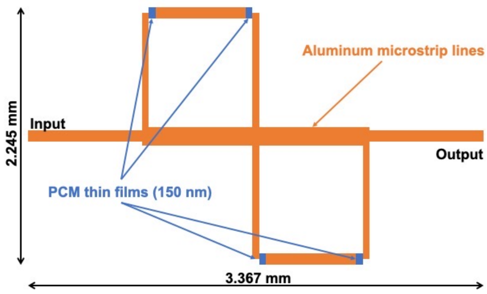
- Co-design passive/active elements
- Classical doping implementation steps
- New degrees of freedom

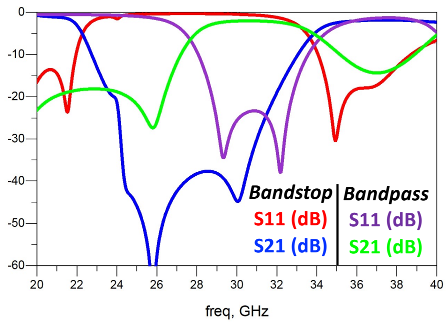


Some proposed concepts of reconfigurable filters and antennas

PCM based bandstop to bandpass filter

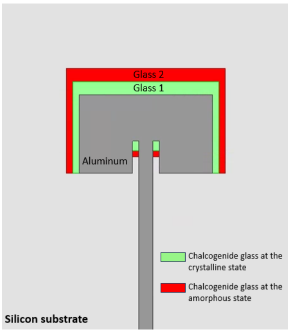
- PCM in amorphous state => Bandstop
- PCM in crystalline state => Bandpass
- Technological characteristics:
  - Substrate Si HR, ε_r=11.9, h=280 µm
  - Metal: Al, σ=3.7x10^7 S.m^{-1}, t=1 µm
  - GST: area width: 10 µm
    layer thickness: 150 nm,
    σ_{cryst}=1x10^5 S.m^{-1}

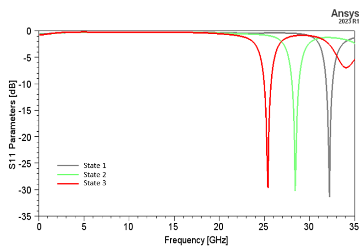


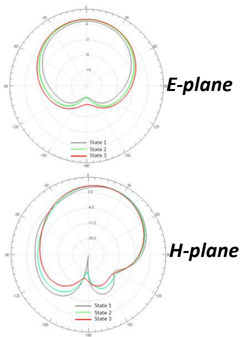


PCM based retractable matching antenna

- State 1: All PCM in amorphous state
- State 2: Green part in crystalline state
- State 3: All PCM in crystalline state
- Reconfiguration
  - Frequency (external parts)
  - Matching level (internal parts)



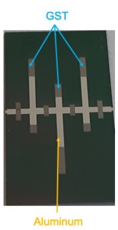


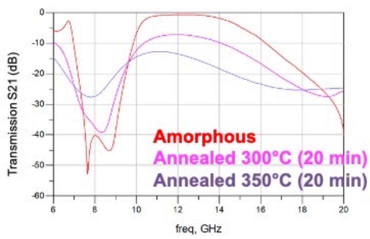


Conclusions

- First encouraging measurements,
- But also a lot of disappointments!
  - ✓PCM deposition problems
  - ✓Defective doping
  - ✓Clean room closure

=> **Results not as good as expected** and a lot of fabrication still in progess





And now?

- **ANR Project** 2024-2028: MACIEO (IETR, Lab-STICC, ISCR and FOTON)
- 2 PhD and a 2-years post-doc
- ***Objectives:*** Fixing the fab process, optimize the PCM, combine both technologies in ambititous devices