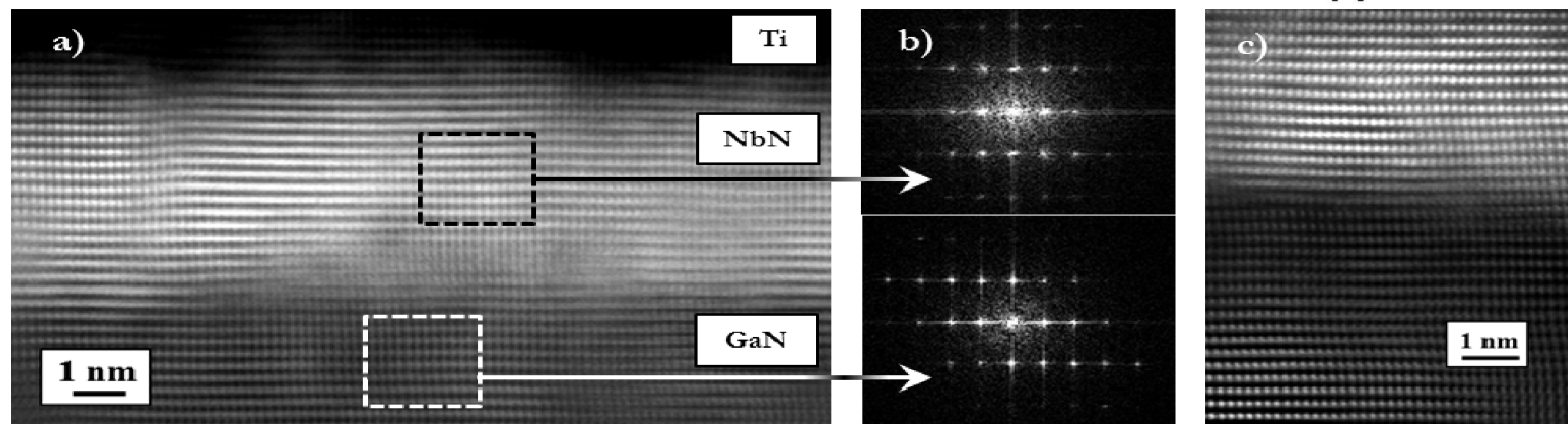
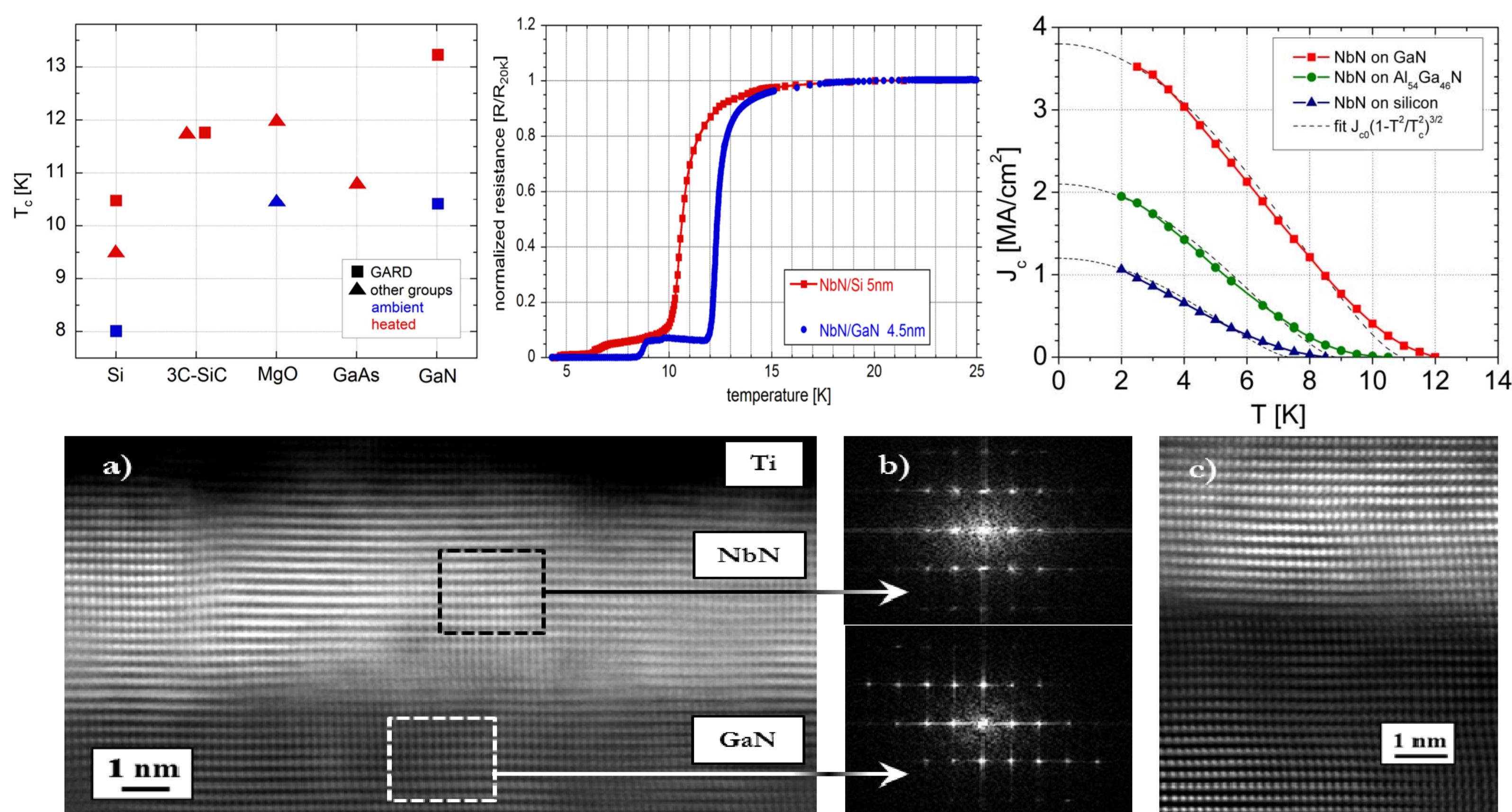


## Group for Advanced Receiver Development, Chalmers University of Technology (Sweden)

### Ultra-thin NbN on GaN buffer-layer

Development of in-house reactive DC magnetron sputtering process yielding high quality films:

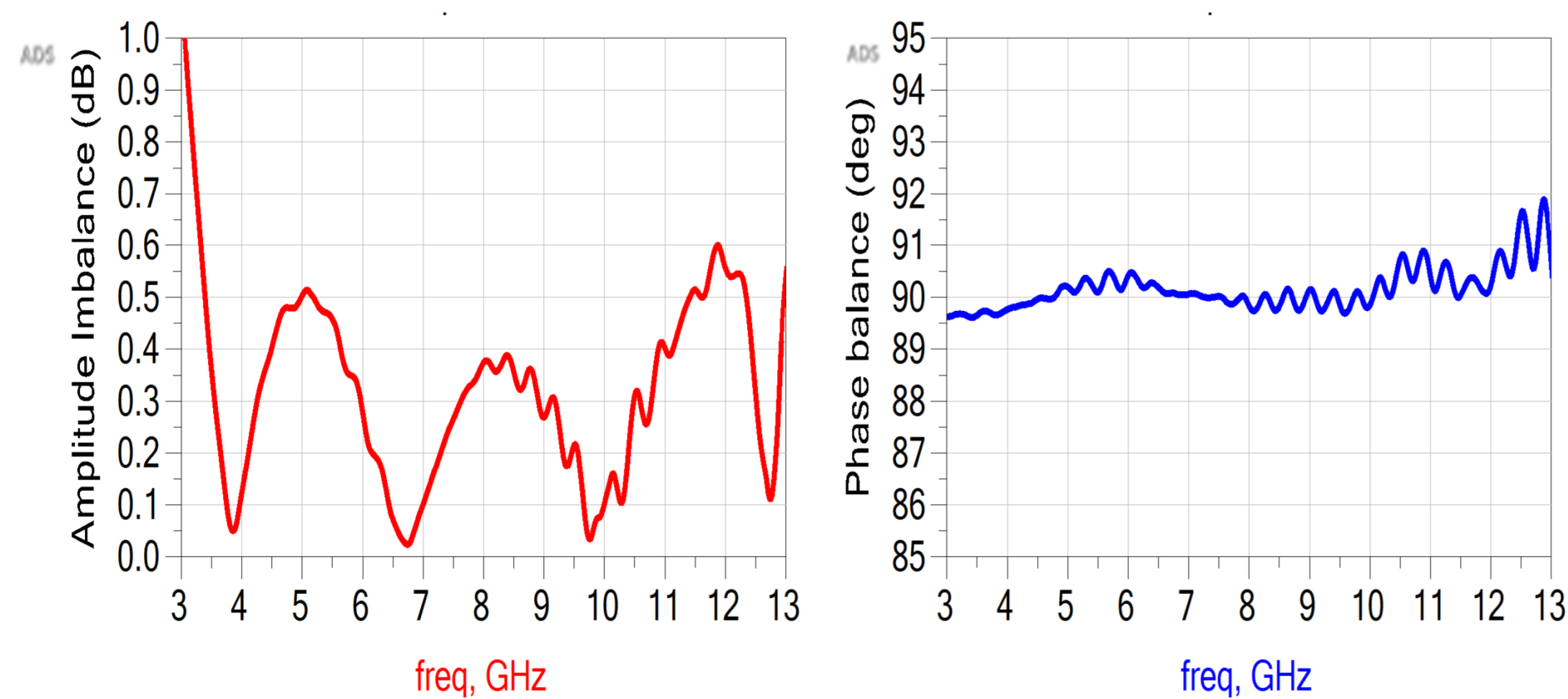
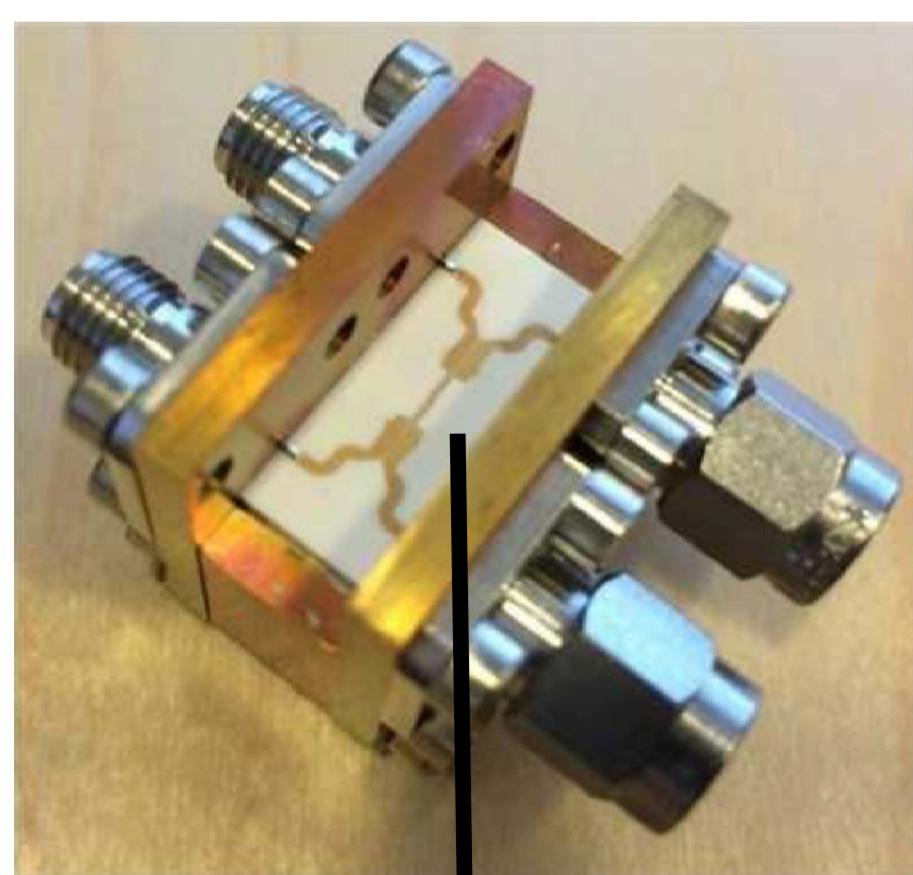
- Epitaxial growth
- $T_c > 13K$ ,  $J_c > 3.5 \text{ MA/cm}^2$
- Possibility to grow epitaxial NbN for ambient temperature deposition



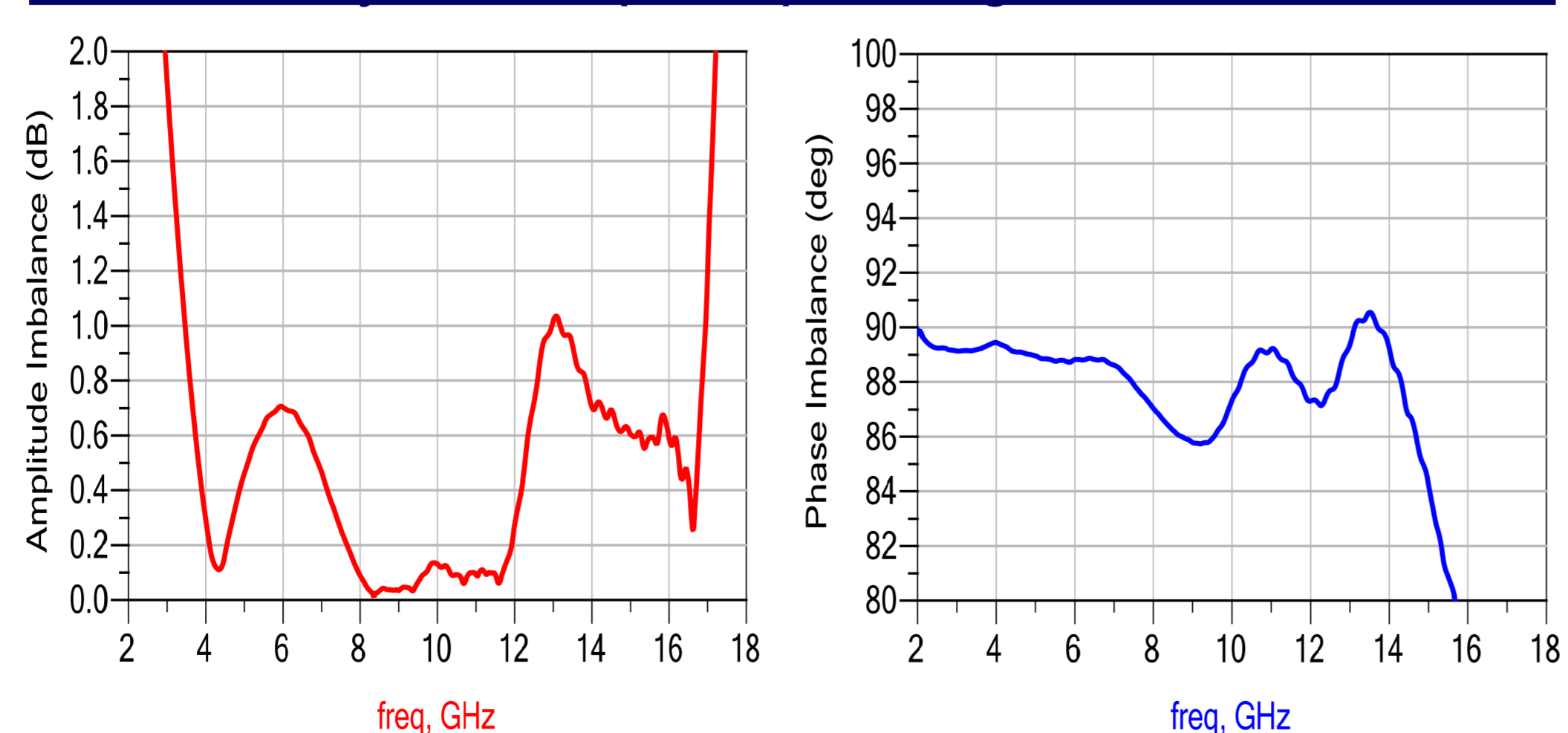
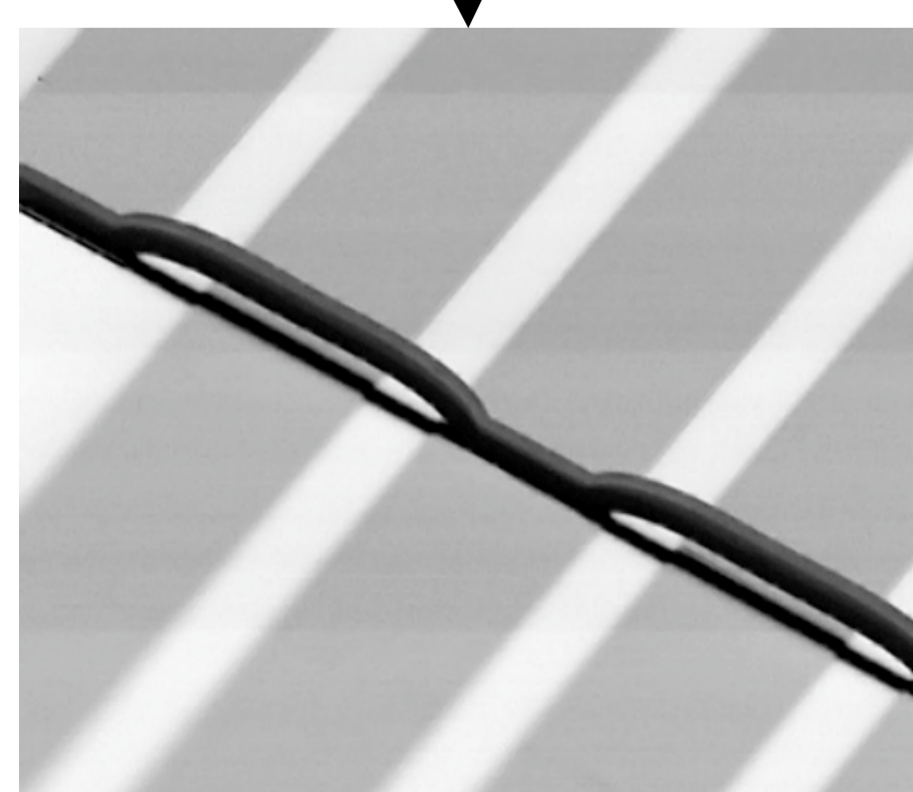
### Wideband compact IF circuits

- Wideband Passives with excellent phase and amplitude imbalances
- Compact, fabricated in house
- Nb or Au microstrip lines and air-bridges
- Can include built-in BiasT

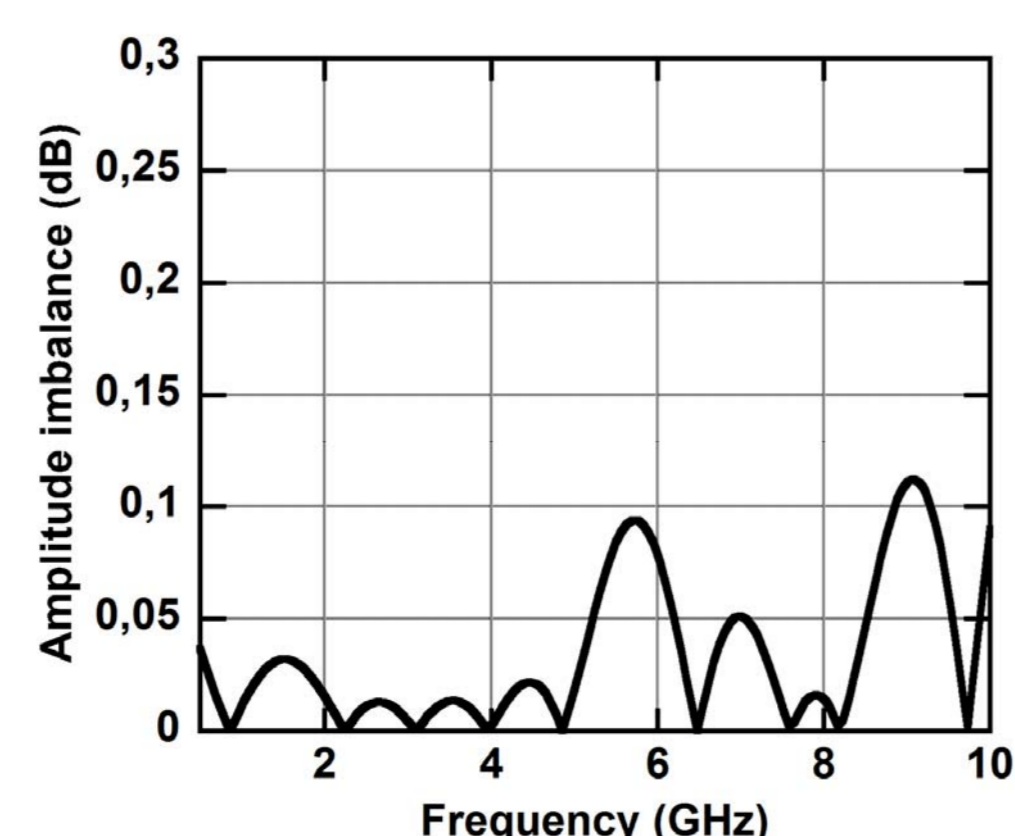
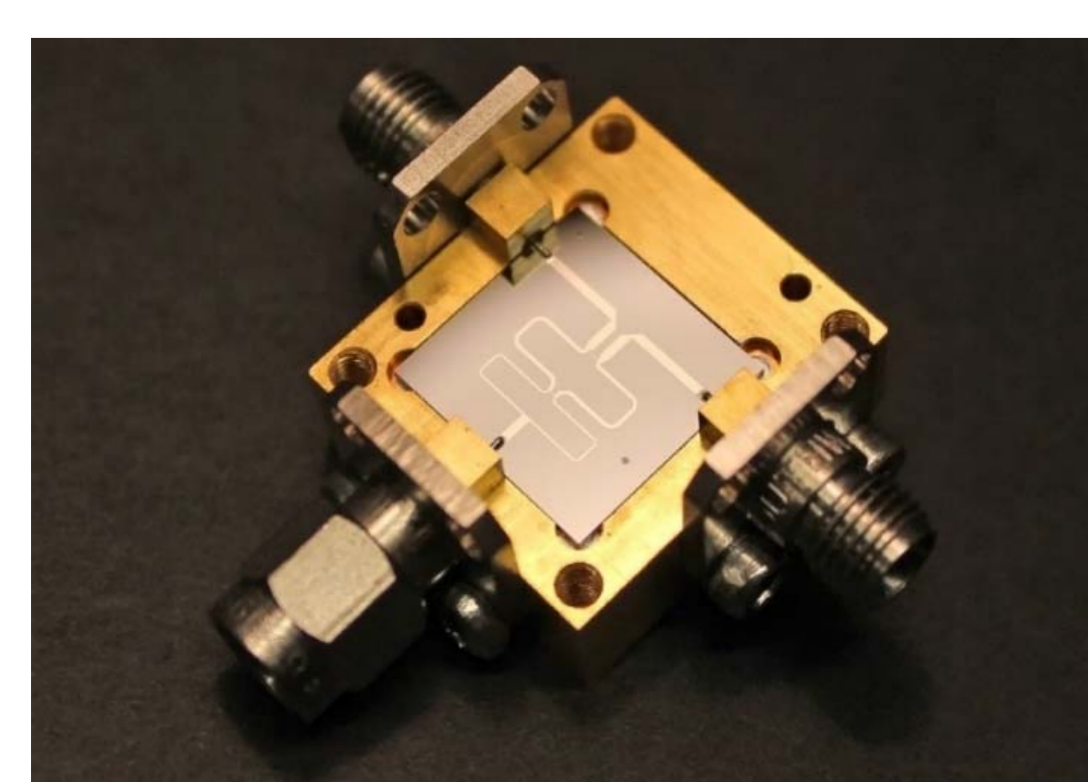
3.5-13 GHz hybrid coupler operating from 300 K to 4 K:



4-16 GHz hybrid coupler operating from 300 K to 4 K:

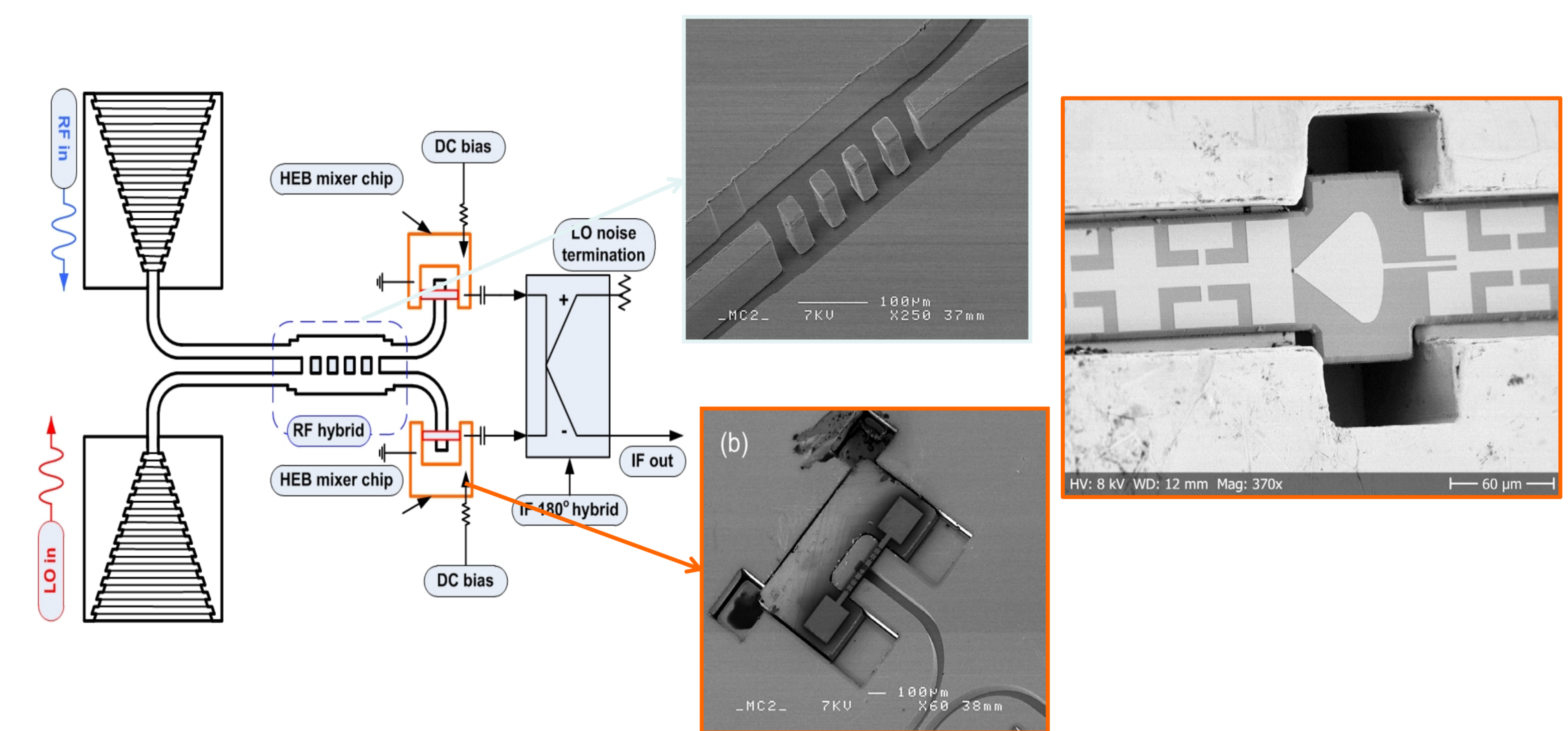


0-10 GHz combiner operating at 4 K:

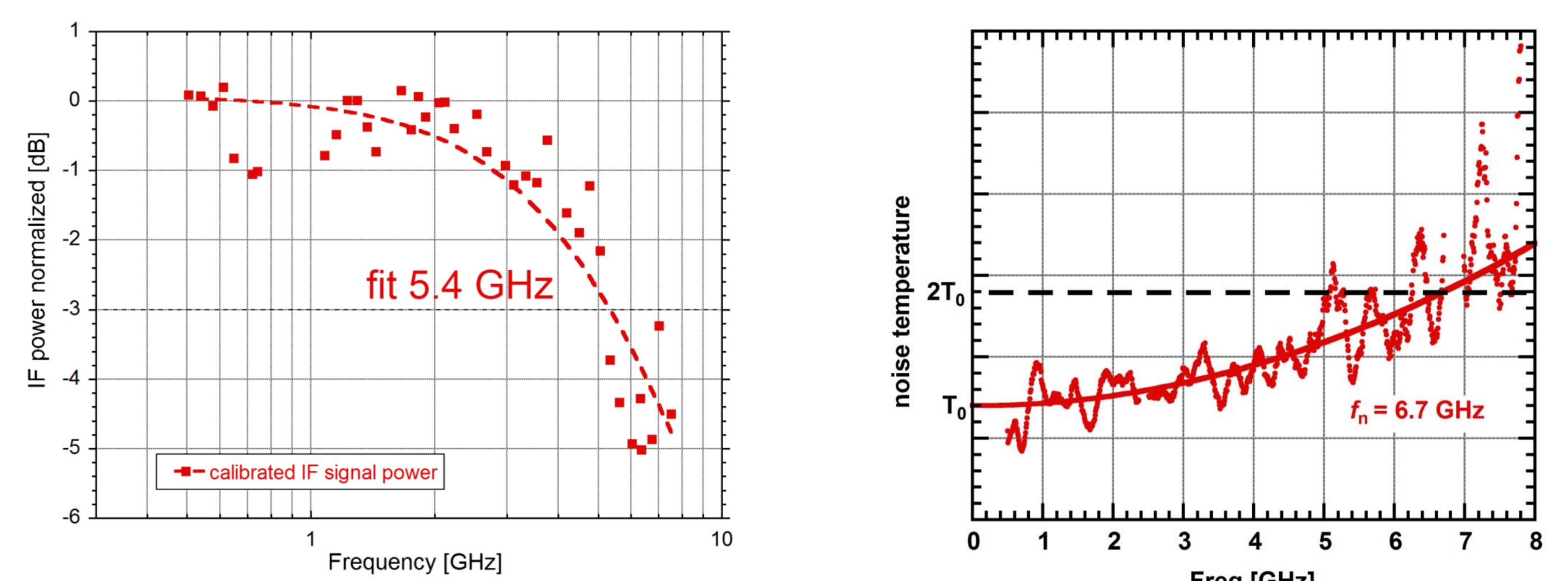


### Balanced NbN on GaN HEB receiver

- Based on NbN grown in-house on GaN buffer layers
- Combination of All-metal waveguide micromachining and Si DRIE etching
- Co-design of chips and waveguide circuits
- Self-alignment of chips to waveguide structures (better than 2 micrometer placement accuracy)



Gain and noise bandwidth measurements at 1.3 THz:



Unprecedented bandwidth for HEB mixers made of NbN on GaN:  $f_n \sim 7 \text{ GHz}$

### Wideband waveguide hybrid couplers

- Wideband (~30% fractional bandwidth) waveguide hybrids with excellent phase and amplitude imbalances.
- Easy to manufacture using standard CNC
- Implemented in ALMA band5 receivers

