Low Temperature Detectors conference n° 17

Microfabrication Developments for future Instruments using KID detectors

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The **NIKA2 instrument**, operating at the 30 meters telescope of the IRAM, demonstrates that the **aluminum LEKID technology** is a state of the art solution for detectors dedicated to **millimeter wave astronomy**. Following this path, several instrumental projects envisage today the use of the LEKID technology. For covering the full **60 GHz – 600 GHz band**, for CMB-oriented experiments, we are exploring new materials and solutions and we present our latest results. Furthermore, we will present an update on our developments for **silicon lenses**, and we introduce different processes to add **adaptation layer on curved surfaces** to reduce reflections at the silicon.

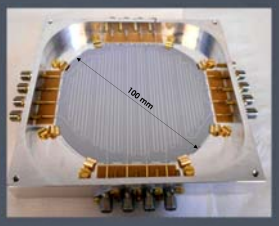
NIKA2 technology : Large array of KID detectors

Telescope on the Pico Veleta (Spain)

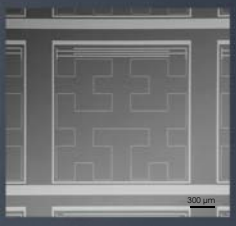
The NIKA2 instrument installed in the cabin (Sept 2015)

1 array for the 150 GHZ band
2 arrays for the 260 GHz band
(polarization measurement)

NIKA2 array (1200 pixels) after the packaging step



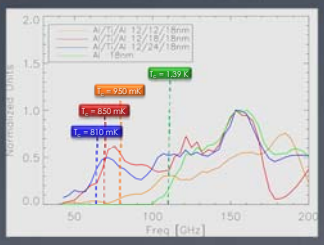
1 pixel of a 260 GHz array with micro-strip feeding strategy



Aluminum 18 nm absorber
Silicon Bulk 270 µm (> 2000 Ω.cm)

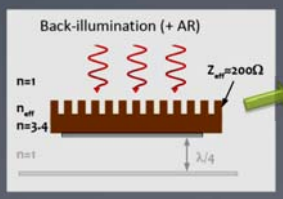
KID developments : other bands of absorption

The 80 – 200 GHz band
(lower than the aluminium 110 GHz cut)

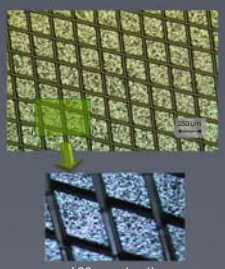


Using proximity effect of superconductors with different tri-layers Al / Ti / Al, to address the < 110 GHz spectral band

Anti-Reflection on back-side array
(With the CPW feeding strategy)



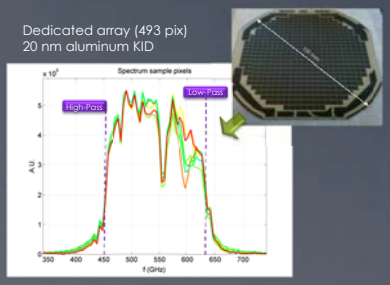
Anti-reflection layer made by micro-dicing saw on the backside of the array



190 µm depth
n_{eff} ~ 1.85

The 450 – 650 GHz band

Dedicated array (493 pix)
20 nm aluminum KID



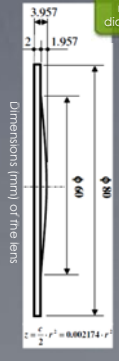
Technology developments for optical devices

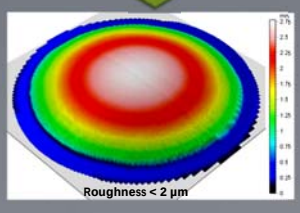
Silicon lens machining
(Lower absorption than the classical HDPE material)

Si monocrystalline (> 1000 Ω.cm) 10 mm thickness 4 inch diameter

Using a 4 axes machine with a diamond grindstone

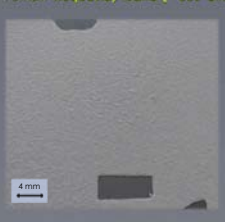
First optical silicon lens





Anti-reflection layer for silicon lens

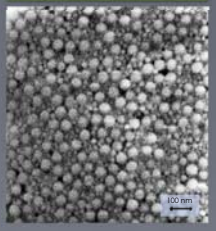
For low frequency band (< 300 GHz)



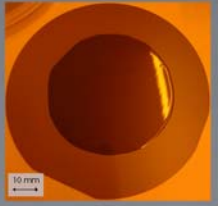
Coating by spraying of silica particles
Thick layer possible (~ 200 µm)
Homogeneity on 4" wafer : +/- 20 µm
Roughness : ~ 20 µm

Side view of the layer

Silica particles size ~ 50 nm
Optical index ~ 1.6



For high frequency band (300 - 700 GHz)



Thermal-bonding of a transparent film

Layer of Rogers® 29-29 Bond-ply (n = 1.7 & thickness 80 µm)

Thermo-compression process: at 190° C under 25 Bar of gas pressure

Development of a lithography process on curved surface

Using a thermo-compression machine to plate and insole a plastic mask

Possibility to decrease the resolution at 10 µm
The depth is adjustable with the DRIE etching step