



HAL
open science

HTSc Josephson nanoJunctions made by ion irradiation for HF operation

J. Lesueur, T. Wolf, N. Bergeal, M. Sirena, G. Faini, R. Bernard, J. Briatico, P. Febvre

► **To cite this version:**

J. Lesueur, T. Wolf, N. Bergeal, M. Sirena, G. Faini, et al.. HTSc Josephson nanoJunctions made by ion irradiation for HF operation. EUROFLUX2009: from devices to circuits and systems, Sep 2009, Avignon, France. <hal-04934664>

HAL Id: hal-04934664

<https://hal.science/hal-04934664v1>

Submitted on 7 Feb 2025

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

HTSc Josephson nanoJunctions made by ion irradiation for HF operation

J. Lesueur¹, T. Wolf¹, N. Bergeal¹, M. Sirena¹, G. Faini², R. Bernard³, J. Briatico³, P. Febvre⁴

¹ LPEM-CNRS, Physique Quantique, E.S.P.C.I., 10 Rue Vauquelin, 75231 Paris, France.

² LPN-CNRS, Route de Nozay 91460, Marcoussis, France.

³ UMR-CNRS/THALES, Route D128, 91767 Palaiseau, France.

⁴ LAHC, Campus Scientifique, Université de Savoie, 73376 Le Bourget du Lac, France

We have developed a technology to make Josephson Junctions with High Temperature Superconductors (HTSc) materials, which produces promising results in term of junctions electrical parameters, reproducibility, reliability and scalability [1].

Starting from a commercially available HTSc thin film, we use ion irradiation (typically 100 keV oxygen) through photoresist shadow masks made by e-beam lithography to make suitable circuits including Josephson Junctions (JJ). High ion dose are used to define superconducting lines, and low dose to make overdamped SNS JJ by depressing locally the superconducting properties on a nanometer scale (20 nm).

Such a technology can be used to build high quality HF circuits provided the spread in JJ characteristics (mainly the $I_c R_n$ product) is low enough and the electromagnetic properties of the materials involved are under control.

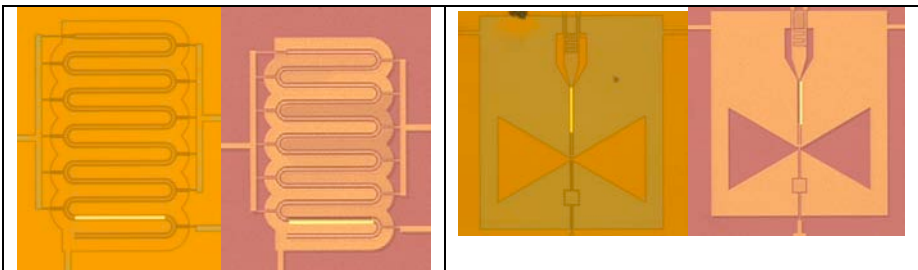


Fig 1 : Resonator (left : e-beam photoresist mask ; right : actual HTSc planar device)

Fig 2 : Bow-tie antenna coupled to a Josephson Local Oscillator (left : e-beam photoresist mask ; right : actual HTSc planar device)

We present a detailed experimental study combined with an accurate modeling of the irradiation damage within the junctions through Monte-Carlo simulations, which allowed us to define new irradiation conditions to keep the spread in the 10% to 15% range, whatever the operating temperature is [2]. Moreover, we have measured the specific properties of CPW lines made with this technology (inductances, capacitances, losses ...), and show that they are compatible with HF operation.

First results on THz operation will be presented.

REFERENCES

- [1] App. Phys. Lett **87**, 102502 (2005) ; **89**, 112515 (2006) ; **91**, 142506 (2007) ; **91** 262508 (2007)
[2] J. of App. Phys. **101**, 123925 (2007) ; **105**, 023910 (2008)