FABRICATION AND CHARACTERIZATION OF ULTRATHIN PBCO/YBCO/PBCO CONSTRICTIONS FOR FURTHER APPLICATION AS HOT ELECTRON BOLOMETER TERAHERTZ MIXERS

A. J. Kreisler[1], *A. F. Dégardin*[1]
Ch. Peroz[1,2], *J-C. Villégier*[2]
M. Chaubet[3]

[1] Laboratoire de génie électrique des universités Paris 6 et Paris 11 (LGEP), UMR 8507 CNRS-Supélec, GIF SUR YVETTE, France
[2] Laboratoire de cryophysique, CEA-Grenoble, France
[3] Centre national d'études spatiales (CNES), Toulouse, France

Superconducting Hot Electron Bolometer (HEB) mixers are a competitive alternative to Schottky diode mixers or other conventional superconducting receiver technologies in the terahertz frequency range because of their ultra wide bandwidth (from millimeter waves to the visible), high conversion gain, and low intrinsic noise level, even at 77 K.
A technological process has been successfully developed for fabricating stacked $YBa_2Cu_3O_{7-x}$ (YBCO) and $PrBa_2Cu_3O_{7-y}$ (PBCO) ultra-thin films (in the 15 to 40 nm thickness range) on a configuration of constrictions (in the 0.8 0.8 to 0.45 0.45 μm^2 range), elaborated on MgO (100) substrates by hollow cathode magnetron sputtering. A combination of electronic and UV lithography steps followed by selective etching techniques were used to realize HEB mixers based on these constrictions covered by a planar gold antenna of the log-periodic type, aiming at covering the 1 millimeter to 30 micrometer wavelength range.

High values of critical temperature in the 85 to 91 K range, as well as critical current densities reaching 2 10^7 A/cm^2 at 77 K were measured (electrical transport); the temperature coefficient value of the resistance was 0.4-0.5 per kelvin. These characteristics were stable upon ageing, thermal cycling and after the gold antenna fabrication step.

Further characterization steps concern the device bolometric response in the direct detection mode at 850 nm wavelength up to 1 GHz modulation frequency. They also concern the device response in the heterodyne detection mode at 2.5 THz, using two gas laser sources.

Study undertaken with CNES support, under contract # 2002/0440/00

Corresponding author : Alain.Kreisler@supelec.fr