Heterodyne receivers are capable of detecting and spectrally resolving fine structures of terahertz wave emission coming from interstellar medium, stars, and planets. For frequencies above 1THz, superconducting Hot-Electron Bolometer (HEB) mixers enable such heterodyne receivers on ground, air- and space based platforms. For HEB mixers, ultra thin superconducting films are required with a ps-rate electron phonon interaction \( \tau_{eph} \), and a fast phonon-to-substrate escape time \( \tau_{esc} \). The resulting electron temperature relaxation time sets the upper limit for the utilizable Intermediate Frequency (IF). So far, such combination of properties has been observed in two materials. In NbN, with a critical temperature of 8-11K in thin films, \( \tau_{eph} \) is about 12ps, and the maximum IF at 4-6GHz. In MgB\(_2\), with a critical temperature of 30K in thin films, \( \tau_{eph} \) is about 1-2ps, and the maximum IF is at 11-13GHz. Besides a wider bandwidth, MgB\(_2\) HEB mixers are much less critical to the cooling, allowing for operation >10K (20K low noise operation has been reported). Despite of obvious advantages offered by MgB\(_2\) HEB mixers, there are two issues, which have to be resolved for efficient operation. Both of these issues are related to a rather low resistivity (hence, sheet resistance) of MgB\(_2\) films, about a factor of 10 lower compared to NbN films. Even for 5nm thick MgB\(_2\) films, the sheet resistance is in the range of 50-70 \( \Omega \)\( /\)\( \mu \)m, which requires the HEB bridges to have an aspect ratio \( w/l \leq 1 \) in order to keep the bridge resistance matched to the impedance of THz antennas (30-100\( \Omega \)). On the other side, due to contact resistance (remember, that HEB mixers operate at a few THz), the width of the bridges has to be kept not too small in order to keep contact losses low as possible. Earlier, we have observed that reducing the HEB width from 1\( \mu \)m down to 300nm the noise temperature is increasing. E.g. NbN HEB mixers have a width 2-4\( \mu \)m. With the first and the second constrains in mind, the optimized for the lowest noise MgB\(_2\) HEB mixers would be e.g. 2\( \mu \)m\( \times \)2\( \mu \)m. The LO power for HEB mixers is known to be proportional to the HEB area. Therefore, optimized for low noise, MgB\(_2\) HEB mixers would require too high LO power.

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