1.9-2.5 THz and 4.7 THz electroformed smooth-wall spline feedhorns for the HEB mixers of the upGREAT instrument onboard SOFIA aircraft

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The upGREAT instrument is the second generation of receivers currently being built for the GREAT project [1]. upGREAT will extend the single pixel GREAT receivers to 14-pixel 1.9-2.5 THz (LFA) and 7-pixel 4.7 THz (HFA) focal plane arrays for much increased mapping efficiency. In order to couple the incoming beam from the main reflector into the waveguide based HEB mixers from KOSMA, it was decided to use smooth-wall spline feed horn antennas similar to [2] and redesigned to match the upGREAT optical requirements. This type of horns has performance comparable to corrugated feedhorn antennas in terms of directivity, return losses, side lobe and cross-polarization levels, but are significantly easier to manufacture using conventional electroforming techniques, as they have smooth side walls. The main challenge comes from the extremely small rectangular waveguide size interface between the horn and the mixers (96 um x 48 um cross-section for the LFA horn, and 48 um x 24 um for the HFA horn). RPG has manufactured high precision mandrels featuring the smooth-wall spline profile horn antenna and circular-to-rectangular transition with micron accuracy using beryllium-copper milling. The mandrels have then been electroplated and etched in order to make the horn antenna. The post-machining tolerance measurements are in-line with the requirements. The underlying design for both feedhorns is similar and for the LFA frequencies a verification of the beam pattern is planned by MPIfR/KOSMA. If proven successful, this will be, to the authors' knowledge, the highest frequency for a electroformed feedhorn manufacturing with performance comparable to that of a corrugated one.

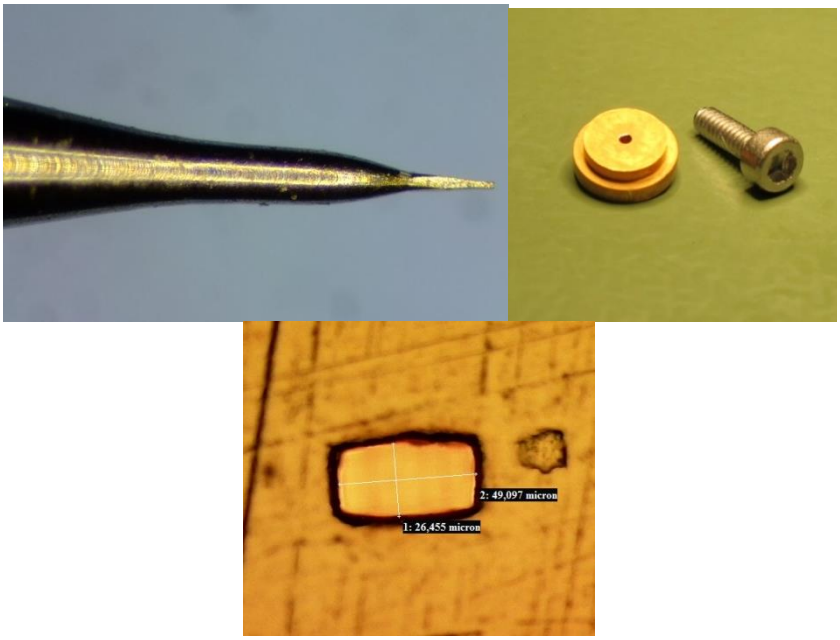

Fig. 1. Left: mandrel for the 4.7 THz horn. Right: delivered 4.7 THz horn antenna.

References

1. upGREAT website at MPI: http://www3.mpifr-bonn.mpg.de/div/submmtech/
2. "A smooth-walled spline-profile horn as an alternative to the corrugated horn for wide band millimeter-wave applications", C. Granet et al., IEEE Trans. on Antenna and Propagation, Vol.52, No.3, March 2004