Far Infrared GaAs BIB Arrays

GaAs photoconductive detectors could extend the spectral response cut-off to 320 µm, well beyond the present limit of stressed Ge:Ga arrays (210 µm). In an international collaboration we started a development program aiming for large format GaAs FIR arrays. The favorable GaAs long wavelength cut-off has been verified by measured response spectra. Sample detectors demonstrated the expected infrared characteristics of bulk type detector devices. A continuous progress in material research has led to the production of pure, lightly and heavily doped n-type GaAs layers using the liquid phase epitaxy technique (LPE) in combination with small tipping boat arrangements. Future arrays for IR astronomy instrumentation demand for material growth facilities, which can produce 1"-wafers. The relatively low doping in bulk-type GaAs detectors always results in a weak absorption of the IR sensitive layer. Modeling of blocked impurity band (BIB) detector types predicts a considerably increased IR sensitivity due to the attainable higher doping of the infrared sensitive layer. However, the modeling gives also an estimate of the material requirements for the n-type blocking layer: Unintentional donor doping must stay below or close to 10^{13} cm^{-3}, a compensation ratio well below 0.1 is needed.

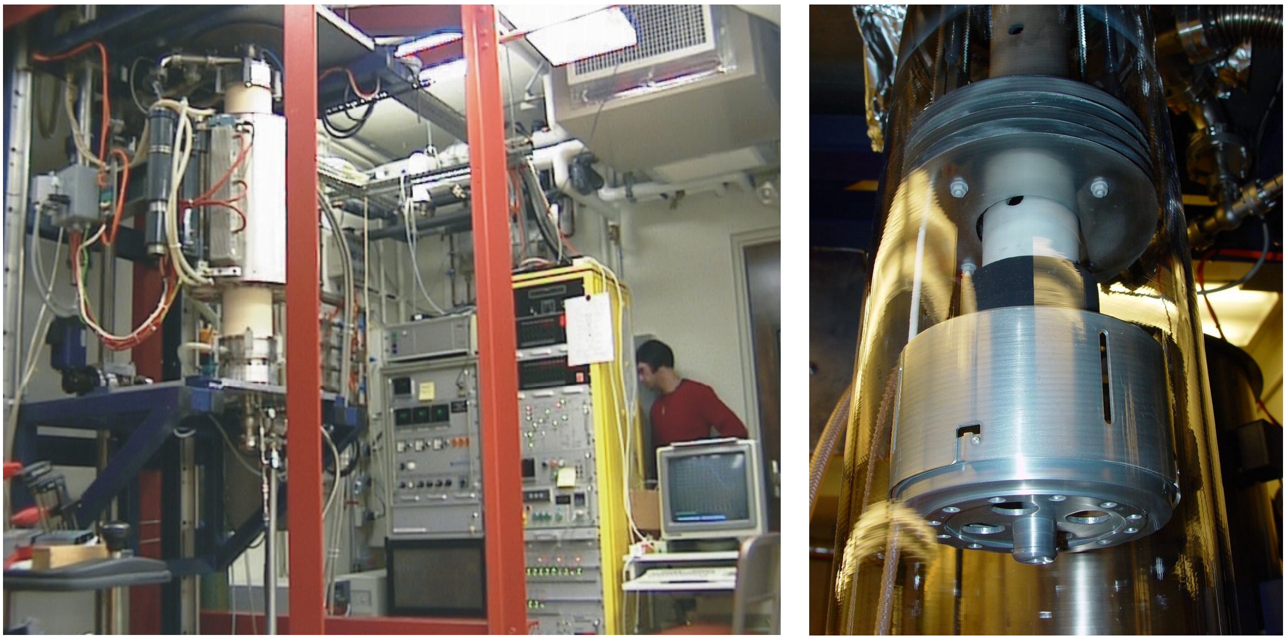

Figure 1a and 1b: Centrifuge facility (left side) and growth crucible inside the SiO_2 reactor

With a new centrifugal technique for the LPE material growth we intend to achieve the high purity, a prerequisite of a suitable blocking layer in a BIB device. Such a growth facility was set into operation at UC Berkeley about one year ago. Contamination from outside during the LPE growth process is reduced by a suspension of the growth crucible on active magnetic bearings in a completely closed environment. A sequential combination of centrifugal and gravitational forces provides the proper transport of the Ga solution inside the crucible. Some details of this equipment are shown in Figure 1a and 1b. Our work will first concentrate on further reduction of unintentional doping, then we can start growth of multi-structured doped / undoped detector layers.

Ref.: R. Katterloher et al., GaAs LPE Growth Centrifuge, Proc. of NASA/Ames USRA/SOFIA Far-IR, Submm, & mm Detector Technology Workshop, April 1-3, Monterey, California (2002)

R. Katterloher, G. Jakob, A. Krabbe, R. Genzel, E.E. Haller, J. Beeman, N. Haegel