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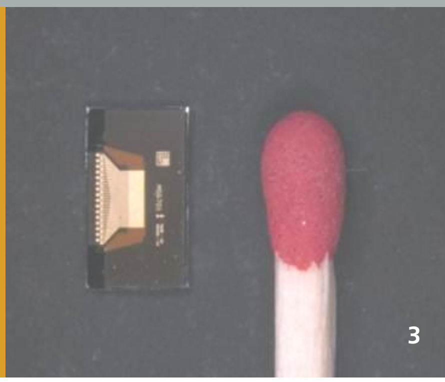
FRAUNHOFER-INSTITUT FÜR BIOMEDIZINISCHE TECHNIK IBMT



1 *1 GHz ultrasound transducer.*
2 *200 MHz ultrasound transducer.*
3 *100 MHz array.*

HIGH FREQUENCY ULTRASOUND TRANSDUCERS

Introduction

Together with the development of modern scanning acoustical microscopes the Fraunhofer IBMT has pursued the objective to manufacture suitable high frequency ultrasound transducers and arrays. Like this, IBMT is able to offer single element focused and unfocused high frequency transducers in a wide frequency range and high frequency ultrasound arrays. The transducers show a high bandwidth and a good signal to noise ratio.

While the single element transducers are scanned mechanically, the arrays allow an electronical scan of the sound beam. In combination with a mechanical scan system, an ultrasound system using array technology is able to scan a surface much faster than a single element system.

Technology

The focused high frequency transducers with frequencies between 100 MHz and 400 MHz possess a sapphire lens with an acoustical matching layer in the lens calotte. The ultrasound is generated by a piezoelectric zinc oxide layer which is physically deposited on the lens body. Zinc oxide is also used in 1 GHz transducers but the lens consists of silicon and its calotte is etched by a wet etching process and is also coated with an acoustical matching layer. The electrical mismatching of the transducers on 50 Ω is minimized by an individual electronical matching circuit. The piezoelectric layers of the arrays may consist of zinc oxide or PZT. In both cases the piezoelectrical layer is deposited by physical vapour deposition. The same technology is used to produce the electrode structure in gold or platinum.

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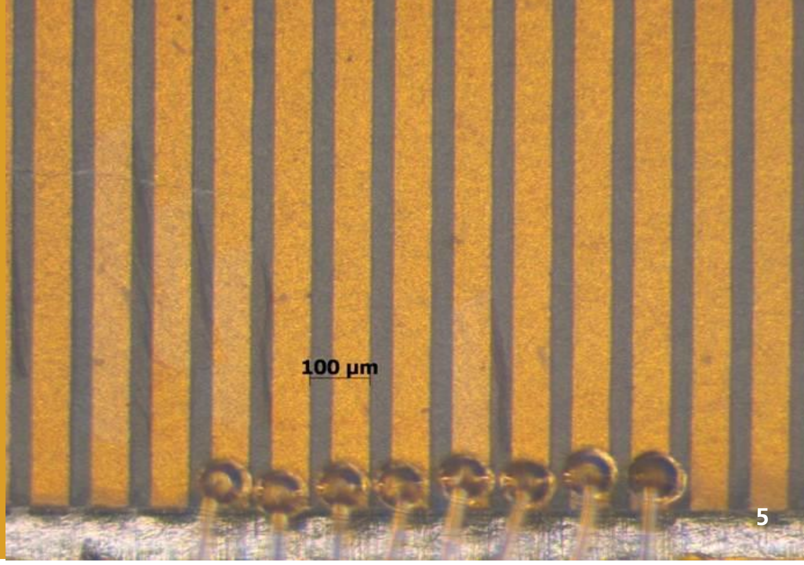
4



5

Applications

In most cases high frequency ultrasound transducers are used in acoustical microscopes. Their most common application is in the field of non-destructive testing. In semiconductor industry, scanning systems are used for the quality control of electronic devices.

Besides this technical application, there are a growing number of scientific groups using acoustical microscopy in biological research. The advantage of acoustical microscopy in this application is the possibility to measure the volume and the mechanical properties of cells.

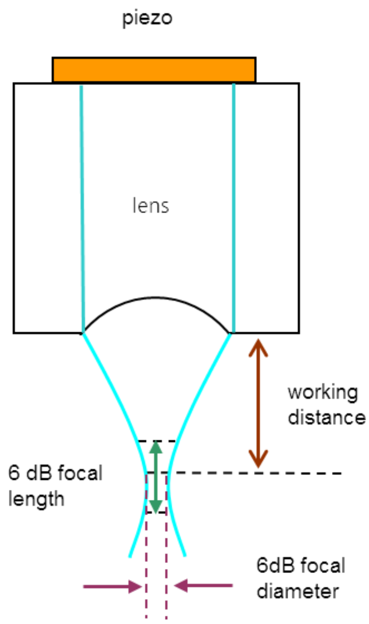
The possibility of a fast electronical scan is a promising feature for future applications of high frequency ultrasound arrays in the non-destructive testing of semiconductor devices. Their application will become possible with the development of high frequency electronics.

Specifications

The spatial resolution and the depth of sharpness of an acoustical microscope depend on the focal diameter and the focal length of the applied ultrasound transducers. Both values correlate to the frequency and the geometry of the acoustical lens of the transducer. IBMT's acoustical lenses are available in standard and customized geometries. Besides the frequency, the focal diameter and length, the housing and the electrical connectors can be adapted individually.
The frequencies of the standard high frequency ultrasound transducers are 100 MHz, 200 MHz, 300 MHz, 400 MHz and 1 GHz.
The typical bandwidth of all transducers is about 50 %.

Table 1 shows the typical specifications of the standard transducers.
Individual customized transducers are also available. Their frequency range is from 100 MHz to 1 GHz.
Please contact us for more information.

4 *100 MHz array on zinc oxide.*
5 *40 MHz array on PZT with bonded contacts.*
6 *Schematic drawing of a sapphire lens with a piezoelectric layer and the distribution of the sound field.*



6

frequency	damping	working distance	6 dB focal diameter	6 dB focal length
100 MHz	10 dB	2000 µm	17 µm	140 µm
200 MHz	12,5 dB	1000 µm	9 µm	70 µm
300 MHz	20 dB	400 µm	6 µm	50 µm
400 MHz	20 dB	250 µm	4,5 µm	35 µm

Table 1