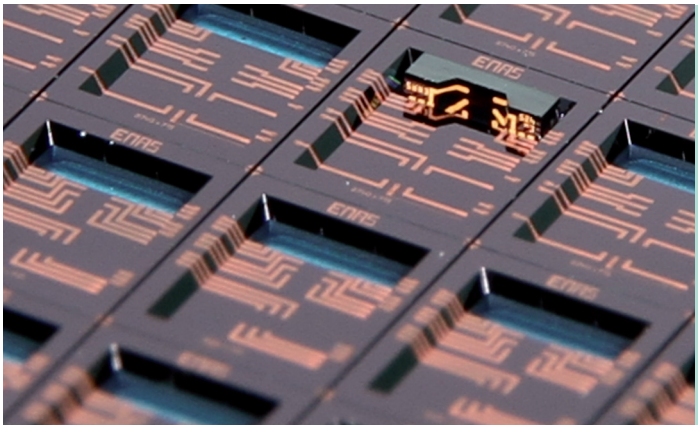
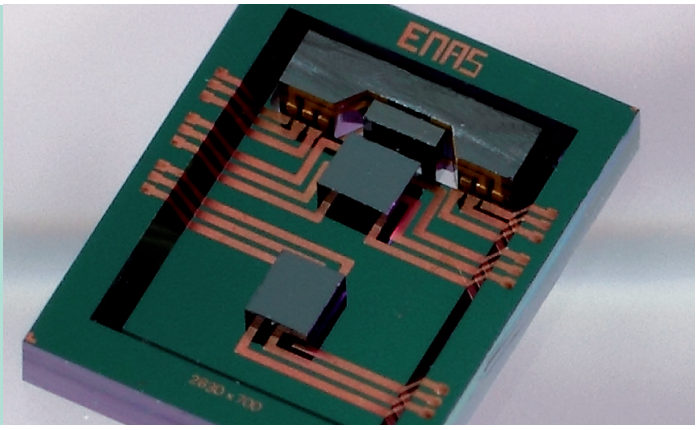
SILICON INTERPOSER TECHNOLOGIES FOR 3D SENSOR SYSTEMS





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Figures: Chip-to-wafer integration: interposer at wafer-level with integrated carrier (left); demonstration sample of a 3D interposer with sensor chips (Sensitec) (right).

Photo acknowledgements: Fraunhofer ENAS

If there is a need for 3D measurement and 1D sensor chips are available, an interposer technology would be used for mounting the sensor chips in X,Y, Z direction. Within the research project MST Smart Sense a Silicon interposer was developed enabling 3D integration of three AMR (anisotropic magneto resistive) sensors into one system for detection of the earth´s magnetic field. The individual sensor chips are oriented precisely that the directional accuracy of the electronic compass should be in a range of 1°.

The interposer system consists of three parts, the 3D interposer, the corresponding carrier device, which is 90° flipped (relative to the interposer) and fixed electrically and mechanically to the 3D interposer, and the AMR sensors for sensing the magnetic field in X,Y and Z axis. To implement this device in consumer electronics the target height of the system should be less than 1 mm. Therefore a trough-hole technology was realized using a combined Si dry etch and wet etch process.

Three AMR sensors are integrated on a Silicon interposer and a carrier device developed by Fraunhofer ENAS. Both the 3D interposer and the carrier device are fabricated on 6 inch Silicon wafer substrates by using common semiconductor technologies. In respect to the small size of the Silicon devices (3D interposer – 4 mm x 5 mm; carrier device – 2.5 mm x 0.83 mm) an efficient production on 150 mm substrates is possible due to the parallel processing on wafer level. PVD and ECD is used to metallized the interposer and carrier device. The carrier device is inserted into a dry etched through Silicon hole. Copper pads (ECD grown and 50 µm thick) connect the carrier device to the 3D interposer. The electrical connection between both devices is done by soldering.

The advanced connection principle is developed for narrow alignment. The interposer technology can be used for a variety of MEMS devices, which have to be aligned 90° and connected perpendicularly to a substrate (3D integration). Using these technologies also other sensor systems could be mounted for 3D measurement.