Leibniz Institute for Solid State and Materials Research Dresden

TECHNISCHE UNIVERSITÄT DRESDEN

Ultra-thin and flexible Hall effect sensorics

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Deutsche Forschungsgemeinschaft DFG

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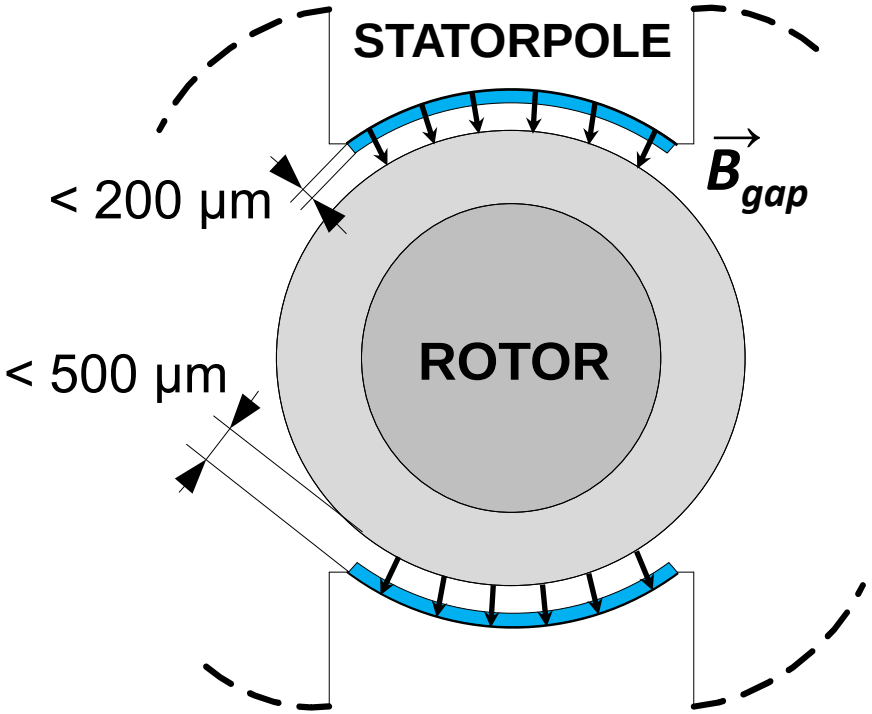
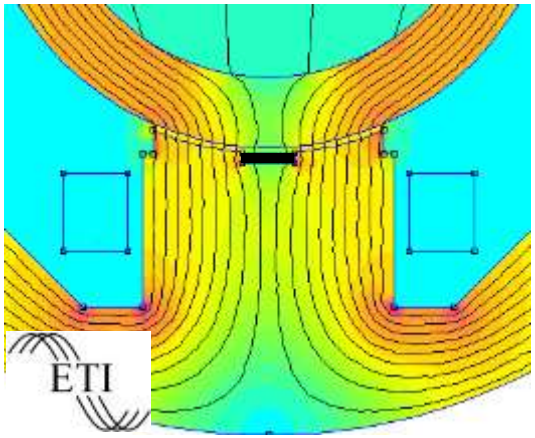
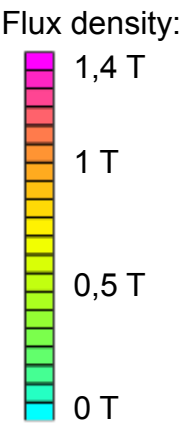
Application potential







- Flux density measurement in the curved and narrow air gaps of electrical machines and drives (e.g. for flux based control of AMBs)

With commercial Hall sensors

→ Element height: ≈ 0,6 mm

- Increasing gap width results in reduced flux density
  → lower magnetic force
- Inhomogeneous field distribution for sensor countersunk in statorpole

Our approach: Integration of ultra-thin and flexible Hall sensors onto the statorpole‘s curved surface

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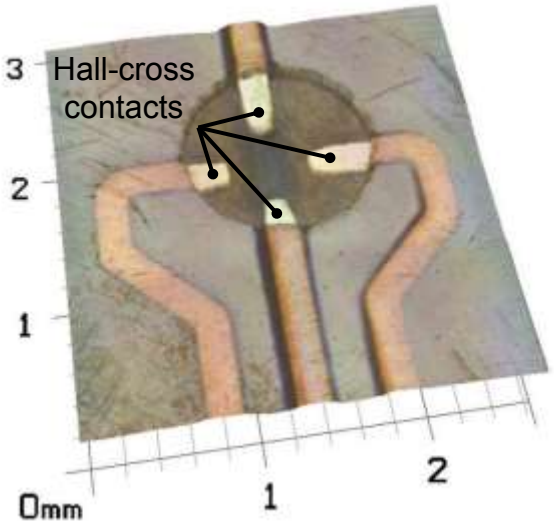
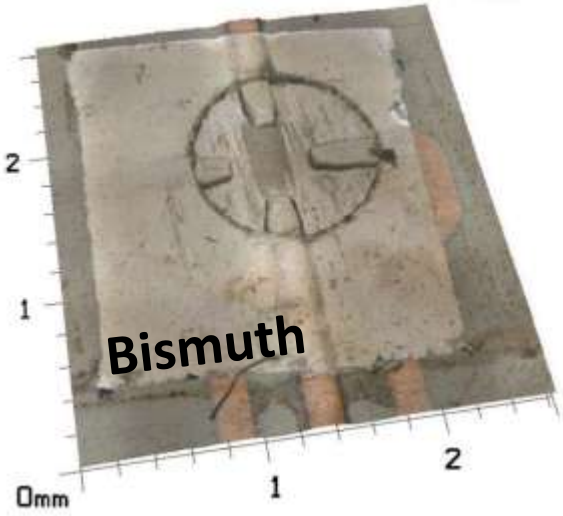
Flexible Hall sensorics



FPC with exposed contacts



Deposited Bi thin film

Sensor on a stator of a brushless motor

Combination of polymeric supports (FPC) and metallic thin films (Bismuth)

- Hall-cross geometry pre-defined by exposed FPC electrodes
- Bismuth deposition by magnetron sputtering

→ Total height of flexible element: 150 µm including wiring

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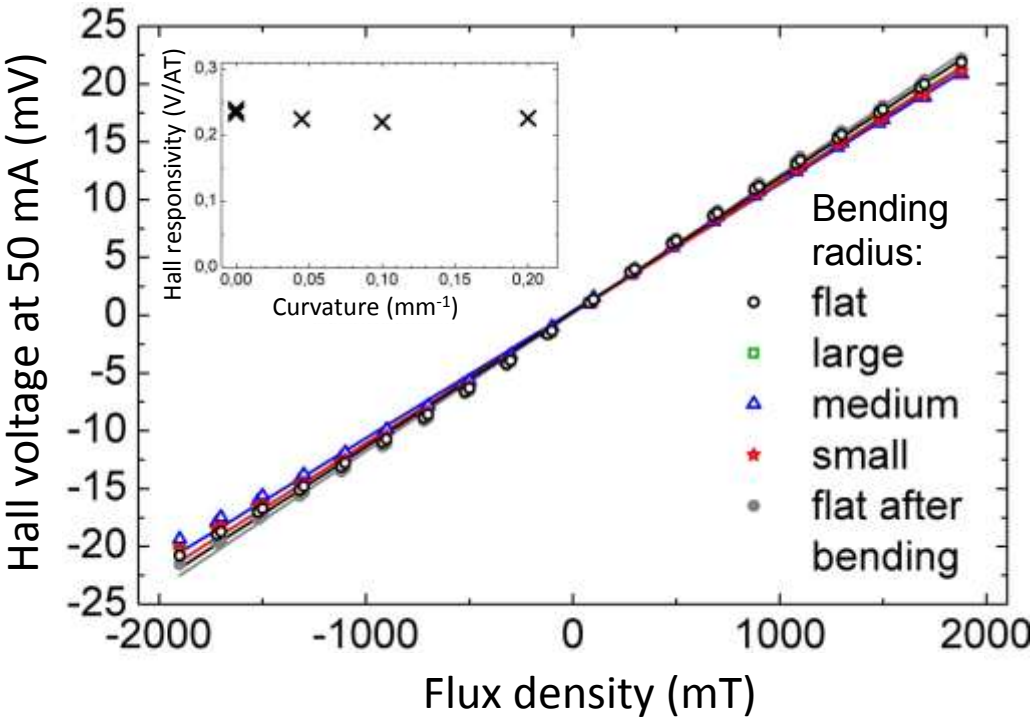
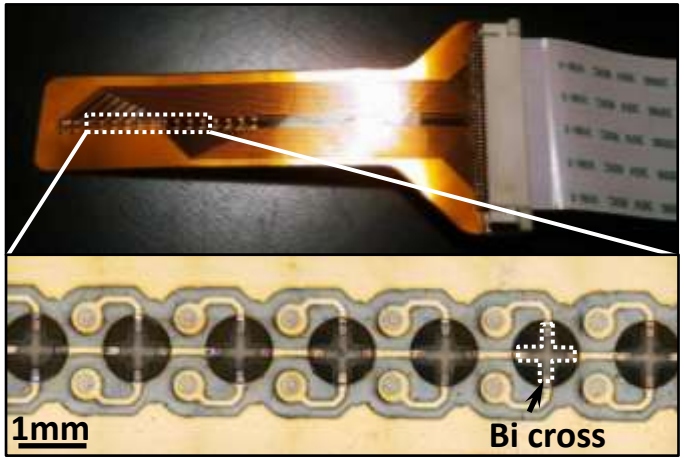
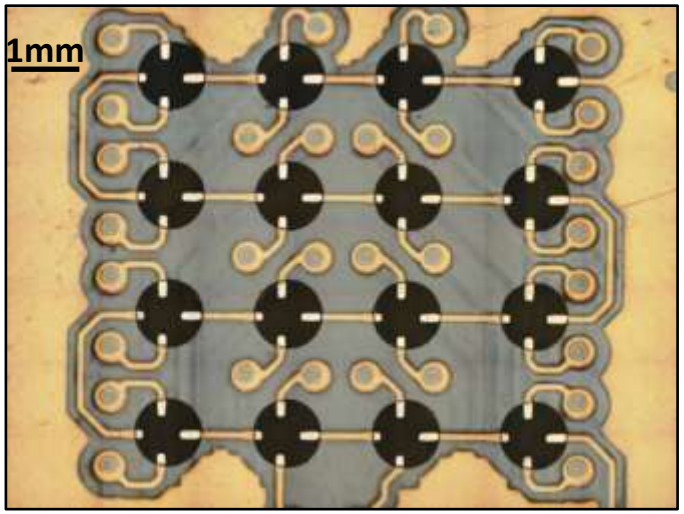
Flexible Hall sensorics

Signal change under bending





Linear positioning sensor



2D magnetic mapping

- Stable Hall signal under bending down to 5 mm radius of curvature
- 16 channel sensor arrays in 1D and 2D configurations

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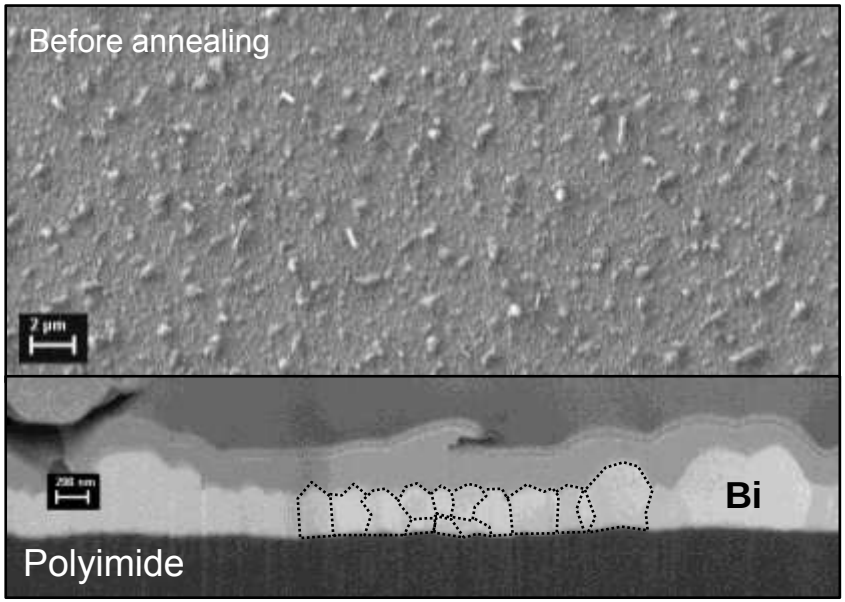
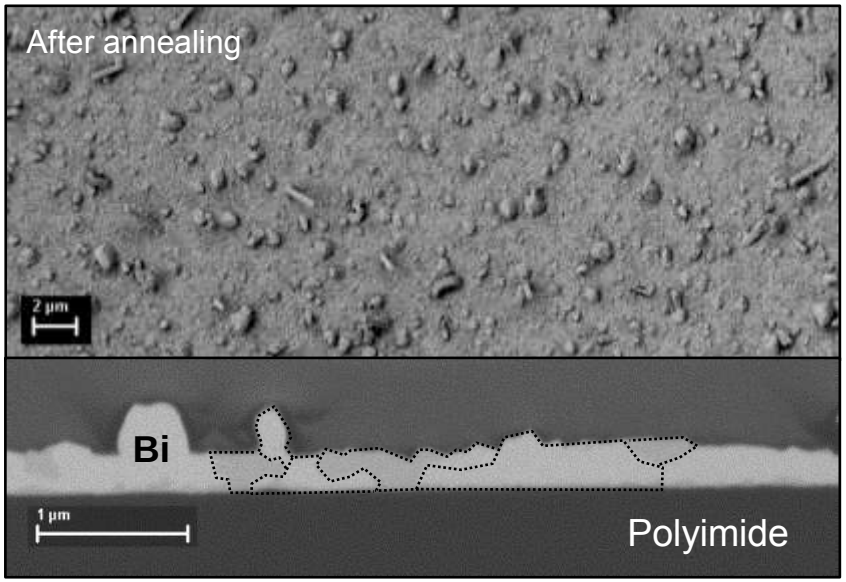
Thermal post-processing



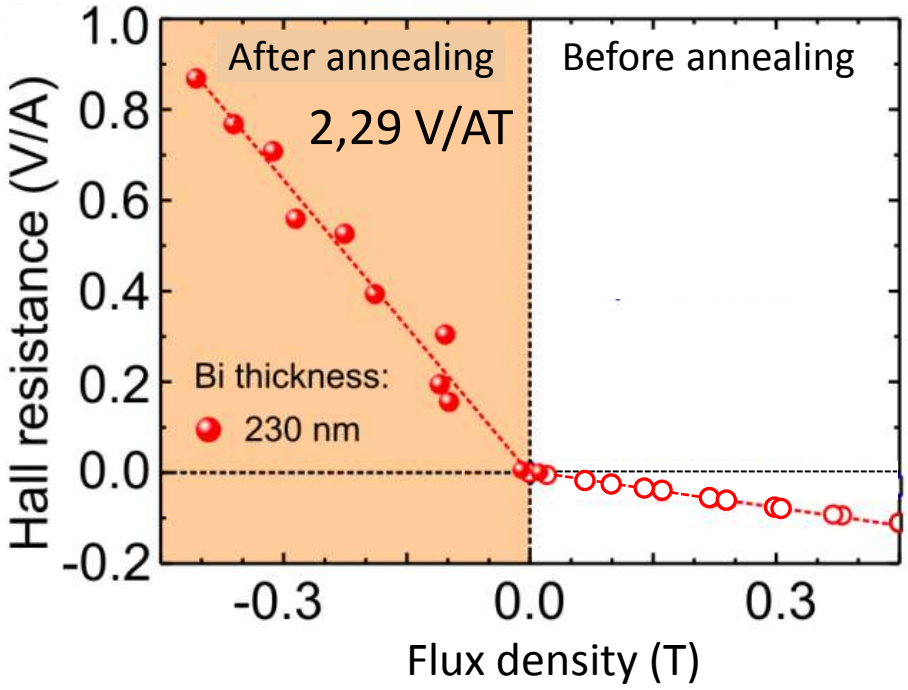


230 nm Bismuth Film

→ Granular morphology

- Post annealing at 250°C for 3h

→ Grain size: 250 nm → 750 nm



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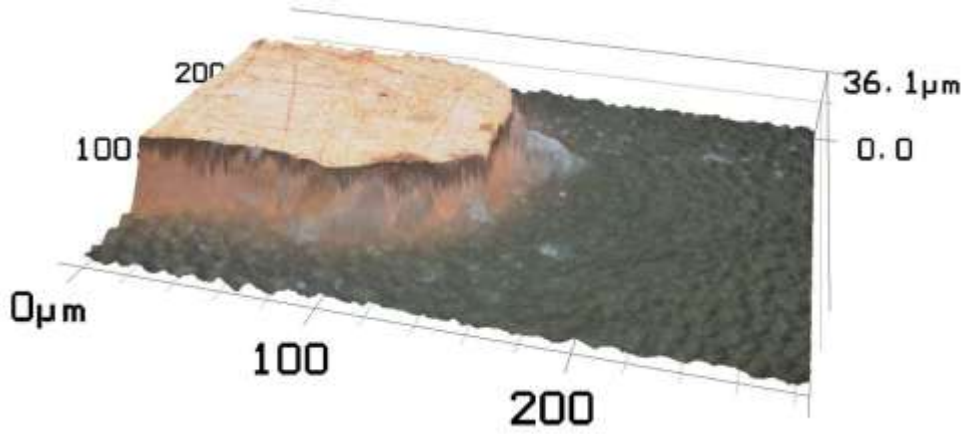
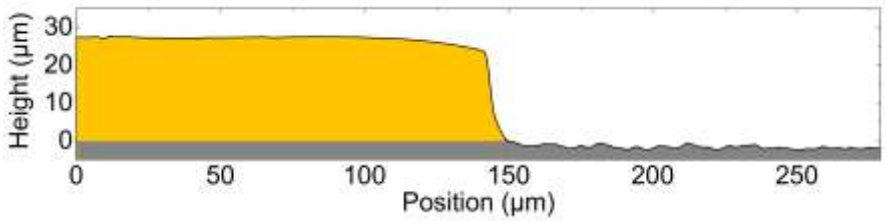
Optimization of contact pads

Cu contact pad on FPC (28 µm height)

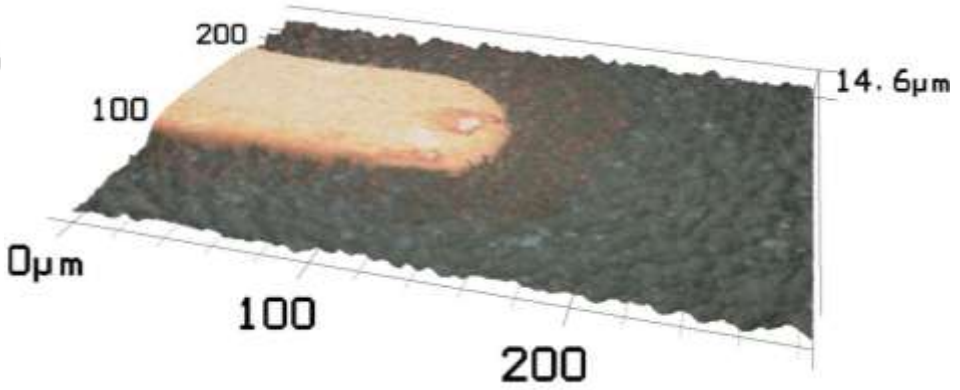
→ Contacting 230 nm Bismuth film

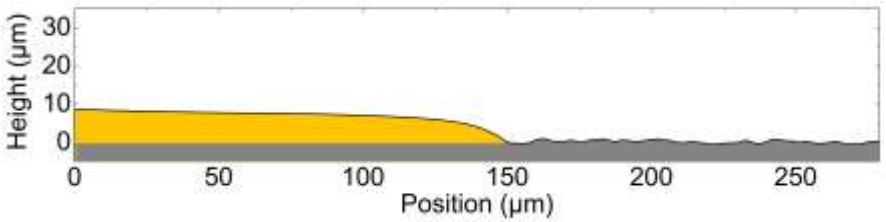




Local electrochemical etching

→ Reduction of contact height





→ Enhanced contact reliability due to smoother pad edge

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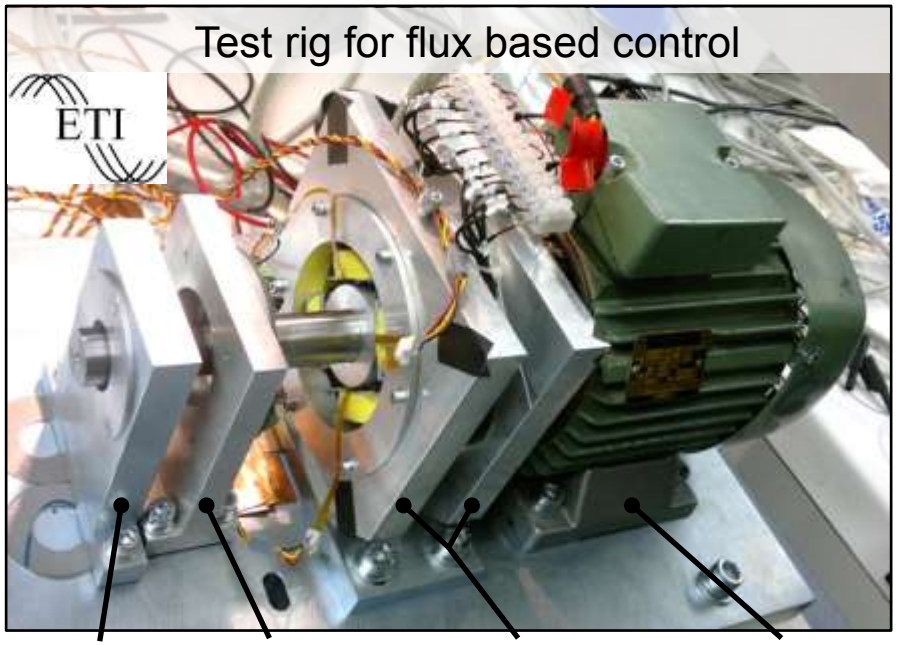
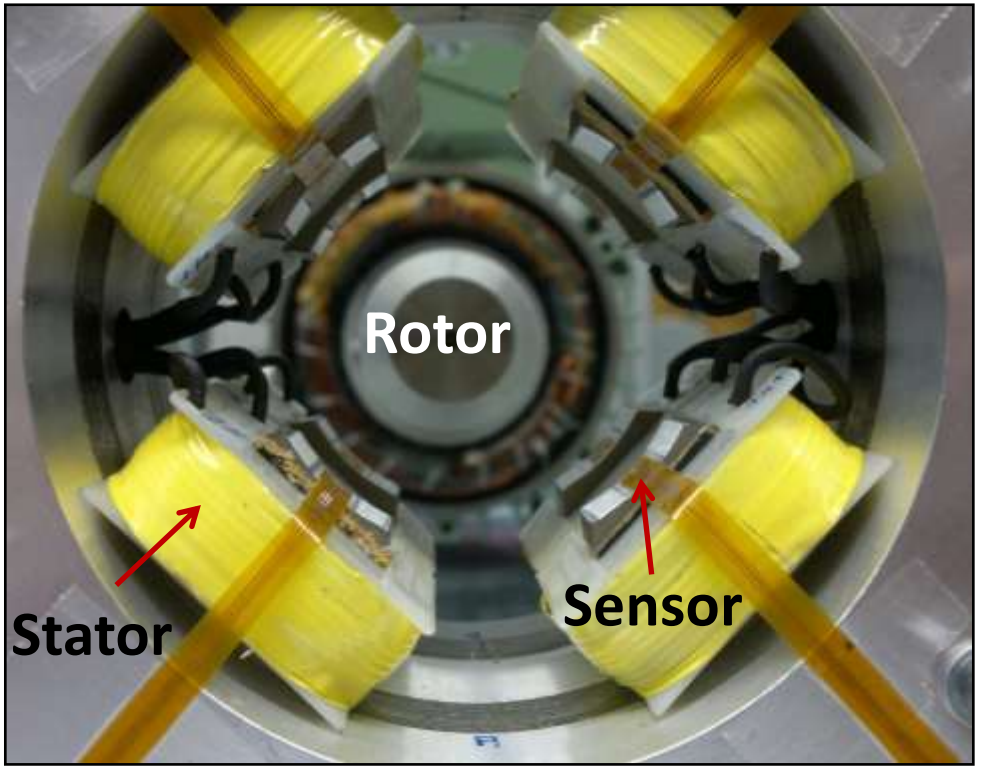
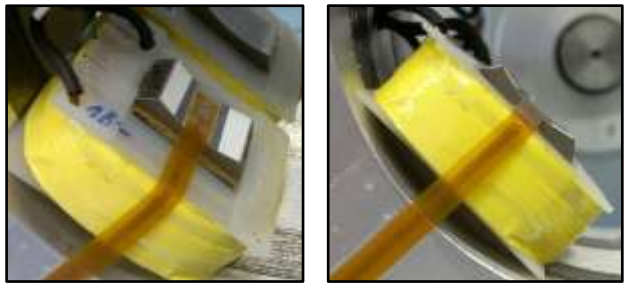
Outlook: Integration into AMB



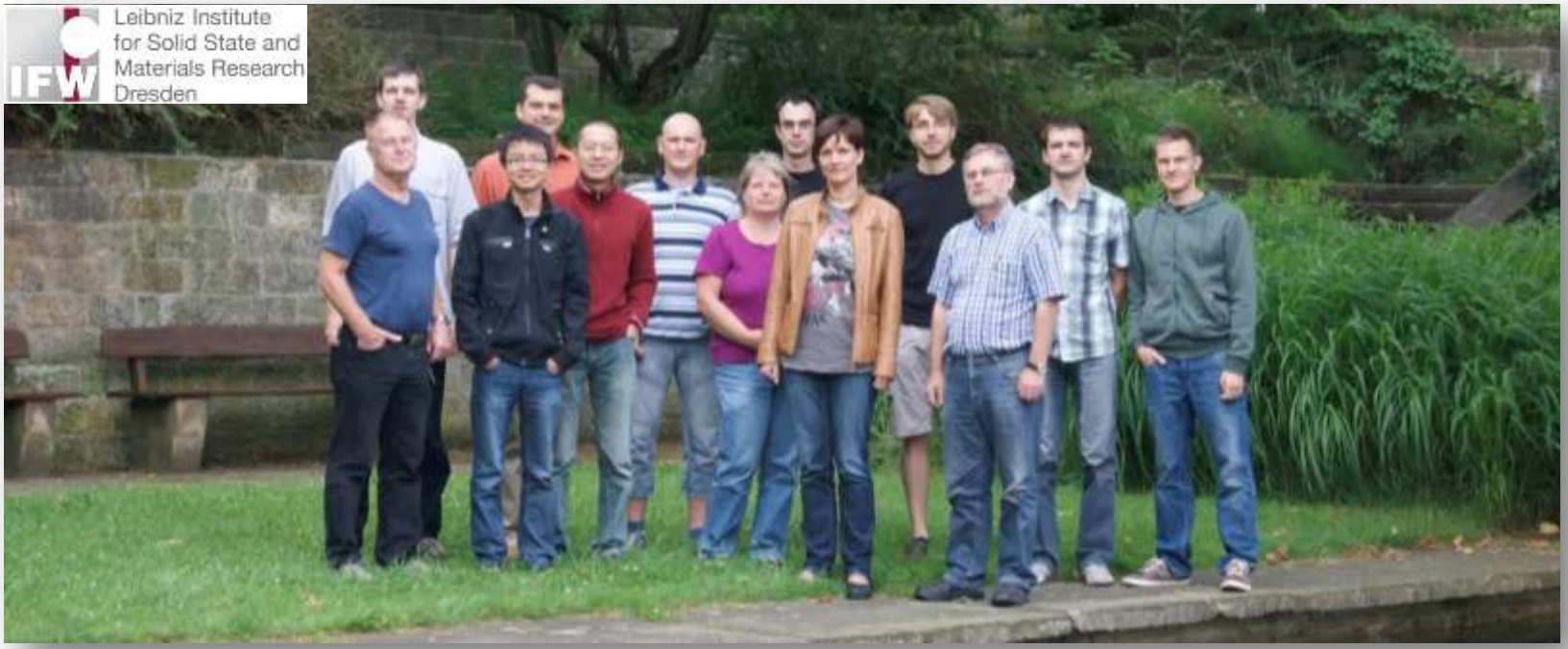


- Radial AMB with permanent pre-magnetization
- Capacitive position gauge
- Integration of 8 individual flexible Bi Hall sensors in the air gap with differential operation



Bi Hall sensor fixed to the AMB stator pole

The MAGNA Group at IFW Dresden



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