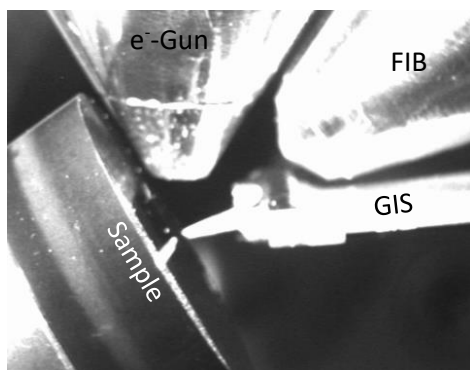


## Focused Ion Beam (FIB) and Gas Injection System (GIS)

One of the high-resolution electron microscopes (SEMs) available at AAC is equipped with a FIB-column. While SEM uses electrons to image the sample, FIB uses a focused beam of  $\text{Ga}^{2+}$  ions instead, which is used to prepare the sample surface.

A multi-channel "Gas Injection System" (GIS) allows to insert minimal amounts of different precursor gases close to the sample surface. The precursor is cracked by the ion beam leading to the deposition of thin solid layers in precisely defined areas.

The CrossBeam<sup>®</sup> setup allows the parallel operation of electron and ion imaging and enables high-resolution live SEM-imaging during FIB-milling.

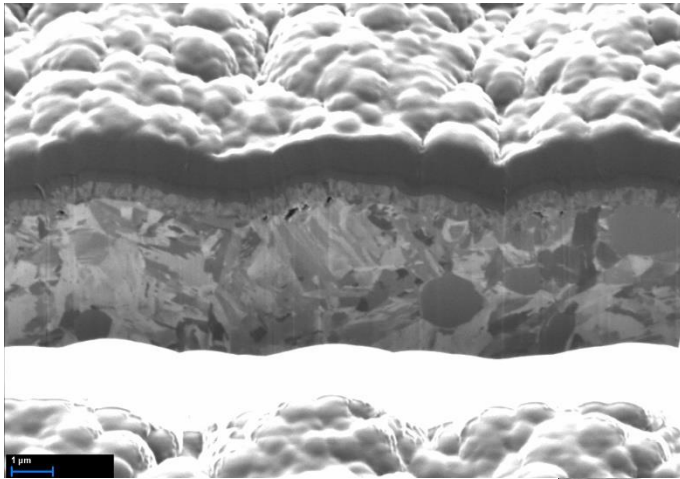


*Figure 1: View of CrossBeam vacuum chamber indicating different sources*

### FIB Applications:

- Specimen preparation within precisely defined areas ( $\mu$ - und nm- scale)
- Cross sections of e.g., thin coatings, multi-layers, composites to assess Interface processes, tribological behavior, phase transformation, homogeneity, damage mechanisms, etc.
- Etching and polishing regions of interest with ions to reveal the grain structure
- Improved orientation contrast ("Channeling Contrast") obtained by ion imaging
- Deposition of thin protective layers in precisely defined areas ( $\mu\text{m}$ - and nm-scale) by application of GIS
- Material Micro-structuring: GIS-deposition and FIB-milling of precisely defined 3D-structures providing micro- and nano-scaled components.

Examples:



*FIB cut to assess coating quality*

*FIB cut revealing improved orientation contrast obtained by ion imaging ("Channeling Contrast")*

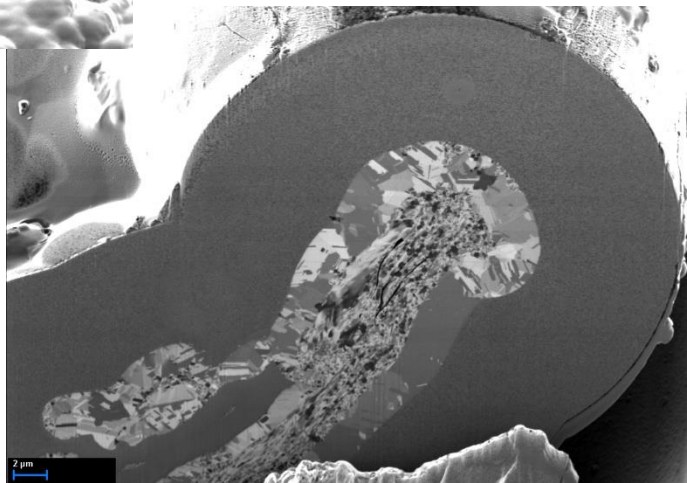


Figure 2: Example for FIB application: Cross-cutting the sample

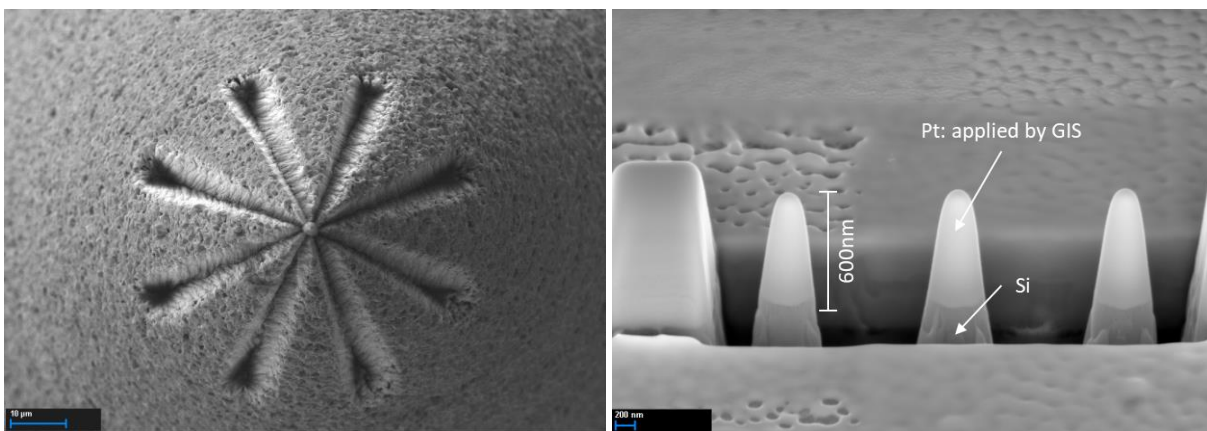


Figure 3: Example for FIB application: Nano-structuring of sample surface