

## UNIVERSAL MOTION CONCEPT AND EULERIAN CRADLES FOR CONTROLLED SAMPLE POSITIONING

Beyond classical phase identification, X-ray diffraction enables you to investigate material and structural parameters. In cases where these parameters show orientation dependence, or the shapes of the objects under investigation are more complex than common powder samples, special sample handling is required.

Any D8 diffraction system can be equipped with a variety of sample stages designed to accommodate numerous analytical requirements and in a number of cases, sample stages can even be equipped with dedicated sample holders.

Comprehensive investigations of residual stress and texture – as well as measurements of thin films, wafers or micro-structures – require the sample rotation ( $\phi$ ) and tilt ( $\chi$ ). Many applications require XY- and Z-translation for precise sample alignment or mapping of structural sample parameters. The additional motorized axes provided by the Universal Motion Concept (UMC) sample stages and the Eulerian cradles convert a simple 2-axis diffractometer into a materials research instrument with up to 7 degrees freedom to handle virtually any sample.

The closed Eulerian cradle is the simplest solution for exclusive performance of texture measurements. With this cradle, a sample can be oscillated to obtain excellent results even from coarse-grained materials.

The open,  $\frac{1}{4}$ -circle and the centric Eulerian cradles can be used for texture, residual stress and all manner of thin film investigations, including high-resolution X-ray diffraction (HRXRD), X-ray reflectometry (XRR), and



Fig. 1. Centric Eulerian cradle mounted to vertical D8 DISCOVER with HI-STAR area detector

in-plane grazing incidence diffraction (GID), provided that the instrument's optical beam path enables these applications.

The UMC series of stages enable to perform all of the applications of which the Eulerian cradles are capable but on larger, heavier or irregularly-shaped samples. The UMC stages are particularly advantageous for residual stress and texture investigations on bulky samples such as XRR or HRXRD mapping of large samples such as wafers or glass lenses. Mounted to a vertical Theta/Theta goniometer, samples remain horizontal when running experiments with a UMC stage.

Optional dedicated sample holders that fit most of the Eulerian cradles or the UMC stages include: vacuum chucks, wafer chucks, knife edge collimators and a zeta/xi tilt stage.



Fig. 2. Closed circle Eulerian cradle on vertical D8 goniometer for texture investigations



Fig. 3. 1/4-circle Eulerian cradle for residual stress investigations



Fig. 4. UMC 300 stage for thin film studies

### UMC Stages & Eulerian cradles

| Name                | Closed cradle          | Open cradle       | Centric cradle         | 1/4-circle cradle | UMC 150      | UMC 151      | UMC 350      | UMC 1516      |
|---------------------|------------------------|-------------------|------------------------|-------------------|--------------|--------------|--------------|---------------|
| Order number        | 7KP22008AB             | C79298A3244D91    | A19D3/A19D6            | C79298A3244D46    | A19D140      | A19D150      | A19D120      | A19D130       |
| Goniometer geometry | horizontal or vertical | horizontal        | horizontal or vertical | horizontal        | vertical T/T | vertical T/T | vertical T/T | vertical T/T  |
| chi [°]             | 0 ... 360              | -64 ... +91       | -11 ... +98            | - 5 ... 95        | -            | -            | ± 10         | -5 ... +55    |
| phi [°]             | unlimited              | unlimited         | unlimited              | unlimited         | -            | unlimited    | -            | unlimited     |
| x [mm]              | ± 6 oscillation        | ± 30              | ± 40                   | ± 75              | 150          | 100          | 300          | 100           |
| y [mm]              | -                      | ± 30              | ± 40                   | ± 75              | 150          | 100          | 150          | 100           |
| z [mm]              | -                      | 0 ... 13 (manual) | 2                      | -1 ... +12        | 50           | 50           | 50           | 50            |
| Mounting sequence   | chi-phi-x              | chi-z-phi-x-y     | chi-z-phi-x-y          | chi-phi-z-x-y     | z-x-y        | z-phi-x-y    | chi-z-y-x    | chi-z-phi-x-y |
| Sample load [kg]    | -                      | 3                 | 1                      | 3                 | 5.0          | 5.0          | 5.0          | 5.0           |
| Sample height [mm]  | -                      | 40                | 40                     | 40                | 133          | 112          | 90           | 90            |
| Weight [kg]         | 18                     | 22                | 15                     | 25                | 40           | 43           | 57           | 64            |

### Dedicated sample holders



Fig. 5. 3" or 5" vacuum chuck



Fig. 6. Wafer chuck



Fig. 7. zeta/xi tilt stage



Fig. 8. Capillary spinner for Eulerian cradle

BRUKER AXS GMBH  
 OESTLICHE RHEINBRUECKENSTR. 49  
 D-76187 KARLSRUHE  
 GERMANY  
 TEL. +49 (0) 721 595-2888  
 FAX +49 (0) 721 595-4587  
 EMAIL info@bruker-axs.de  
 www.bruker-axs.de

BRUKER AXS, INC.  
 5465 EAST CHERYL PARKWAY  
 MADISON, WI 53711-5373  
 USA  
 TEL. (+1) (800) 234-XRAY  
 TEL. (+1) (608) 276-3000  
 FAX (+1) (608) 276-3006  
 EMAIL info@bruker-axs.com  
 www.bruker-axs.com