

# Texture Analysis of a Cu Wiring Film using the Orientation Distribution Function (ODF)

## Introduction

Since there is a strong relation between the material characteristics and the crystal orientation of metals and many other industrial materials, quantitative analyses of crystallites orientation and their distributions are of great importance. Pole figure measurements are a common method to quantitatively analyze orientation. In this Application Byte, we used the Orientation Distribution Function (ODF) to evaluate the crystallites orientation of a Cu wiring film from a pole figure measurement.

## Measurements and results

For quantitative orientation analyses, it is crucial to obtain accurate pole densities. For this reason, defocusing corrections and absorption corrections are performed. By using a CBO-f on the incident side that converts the line focus to a point focus, and a PSA (Parallel Slit Analyzer) on the receiving side, we performed a measurement while avoiding any decrease in intensity by the defocusing. When evaluating thin films, it is necessary to perform an absorption correction based on the thickness of the film and its absorption coefficient. For this correction, we first calculated the layer thickness from an X-ray reflectivity measurement and used it together with the absorption coefficient to acquire an absorption correction curve (Fig. 1). We then performed a correction of the pole figures of the Cu wiring film.

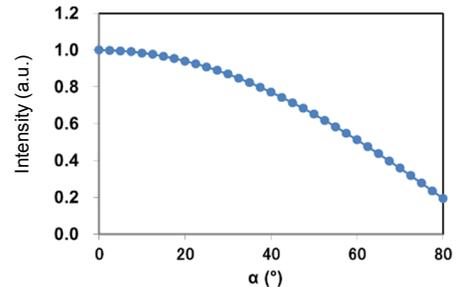


Fig. 1: Absorption correction curve of the 0.2 μm Cu film

Fig. 2 shows the pole figures of (111) and (200) of the Cu wiring film after the corrections. From Fig. 3 we understand that the (111) pole figure has a ring of low pole density at  $\alpha = 57^\circ$  different from the main orientation, so does the (200) pole figure at  $\alpha = 15^\circ$  and  $78^\circ$ . The analysis of the Cu wiring film based on the Orientation Distribution Function showed that besides [111], also the orientations [511] and [100] exist towards the Normal direction ND (Fig. 3). Thus it is possible to quantitatively analyze the oriented texture by calculating the volume fraction.

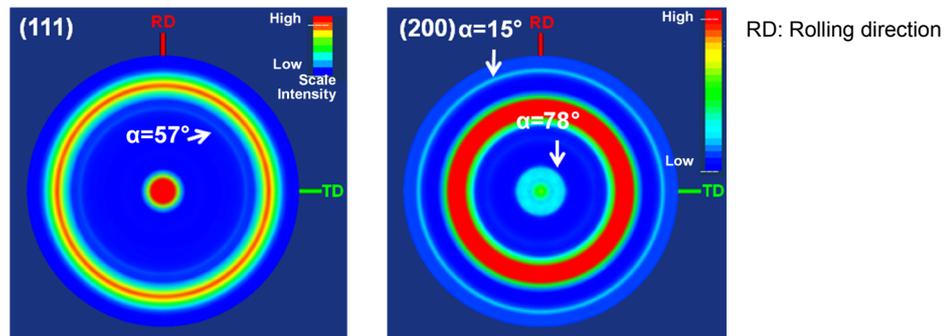


Fig. 2: Pole figures of (111) and (200) of the Cu wiring film

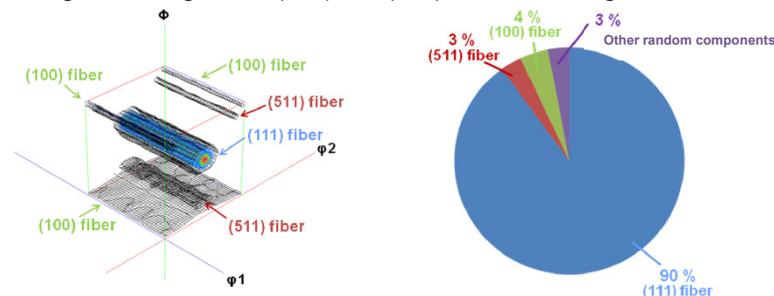


Fig. 3: ODF Analysis of the Cu wiring film

### Recommended equipment and software

- ▶ Ultima IV Multipurpose X-ray Diffractometer + Multipurpose Attachment ML4 + CBO-f
- ▶ SmartLab Automated Multipurpose X-ray Diffractometer +  $\alpha\beta$  Attachment + CBO-f