Evaluation of the Thickness, Density and Roughness of Nano Thin Film
- X-ray Reflectivity (XRR) -

The X-ray reflectivity method provides a means for evaluating the thickness, density and interface roughness of thin films and multi-layer films on the nanometer scale.

**Characteristics**
- It is possible to evaluate film several nm to 200nm in thickness.
- If the composition is already known, the density of the film can be evaluated.
- Not only single-layer film but also multi-layer film can be evaluated.
- XRR is applicable to a broad range of materials from thin semiconductor film to thin super conductive, magnetic, metal and polymer films.
- XRR is applicable regardless whether the materials are crystalline or noncrystalline.
- XRR can be carried out on a nondestructive basis.

**Comparison of nano thin film evaluation methods**

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<tr>
<th></th>
<th>XRR</th>
<th>SEM+TEM</th>
<th>Ellipsometry</th>
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</thead>
<tbody>
<tr>
<td>Film thickness</td>
<td>○</td>
<td>○ (local, destructive)</td>
<td>○</td>
</tr>
<tr>
<td>Film density</td>
<td>○</td>
<td>×</td>
<td>×</td>
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<tr>
<td>Roughness</td>
<td>○</td>
<td>△ (local)</td>
<td>△ (by light transmission)</td>
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**Example of analysis: Evaluation of Si₃N₄ film prepared by the sputtering method**

As a result of analysis, it was found that the Si3N4 film was not of a single-layer structure but had a low-density layer as the pole surface layer. This has not been detected by other analytical equipment, and the layer structure that had not been assumed at the time of design was made clear.