Indium Tin Oxide (ITO) for deposition of transparent conductive oxide layers
High Density Ceramic TCO Sputtering Targets: Indium Tin Oxide (ITO)

Rotary ceramic sintered ITO targets for display applications

ITO for CF plane in TFT-LCD (Gen 8.5)

ITO coated film for projected capacitive touch sensors

- Materials cost
- Labour cost
- Energy cost
- Machine cost

Cases 1-3: assume sprayed rotary silicon is used for SiO₂ deposition. Case 4: bonded, cast rotary Si is used for SiO₂ deposition. Includes 15 % extra relative loss due to nodule removal.

Yielded production with 1 target

Yearly production

Yielded production for 1000 $ spent in sputtering targets

Cost ($/unit)

- 31.9 %
- 40.4 %

- 18.1 %
- 22.7 %
- 33.8 %

- 34.8 %
- 57.4 %

- 34.8 %
- 57.4 %
- 31.9 %
- 40.4 %
Electro-optical properties of ITO thin films on glass obtained under various sputter conditions with UMICORE rotary ceramic ITO (90/10) targets

ITO-90/10 thin film properties vs. reactive gas flow. All depositions with rotary magnetron at 10 kW/m and 2.8E-03 mbar on optically clear glass substrate (Schott B270, 1 mm). Coating thicknesses: 145 nm for RT; 113 nm for $T_{sub} = 180^\circ C$. Absorption data include the glass substrate. Minimum RT resistivity depends strongly on residual water partial pressure in the coater.

Transmission, reflection and absorption curves as measured with a spectrophotometer for 145 nm (RT) resp. 130 nm (230°C) coatings on glass (Schott B270, 1 mm, glass is included in the measurements). Coatings were obtained with a rotary cathode at 10 kW/m and at 2.8E-03 mbar with 2% O2 in the gas flow.

Electro-optical properties of 115 nm ITO (90/10) coatings against glass substrate temperature during deposition. All coatings were deposited with a single rotary magnetron at 10 kW/m, and 2.8E-03 mbar total pressure (2.0% of O2 in the gas flow). All coatings obtained via dynamic depositions: two passes at 1.54 m/min. Typical dynamic deposition rates (DDR) vary between appr. 86 nm.m/min and 104 nm.m/min. The absorption data include the glass substrate and have been obtained with a Spectrophotometer.
## Specifications

### Physical Data

- **High density grade**: ≥ 99.5% of TD
- **TD (theoretical density)**: 7.14 g/cm³
- **Flexural strength**: ≥ 150 MPa
- **Electrical resistivity at 20 °C**: < 0.2 mΩcm
- **Thermal conductivity**: at 20 °C: 11 – 12 W/mK at 250 °C: 10 – 11 W/mK
- **Appearance**: black

All physical data are based on ITO with a 90/10 wt% ratio. Further physical data available upon request.

### Chemical Composition

In₂O₃/SnO₂ in a 90/10 wt% ratio (consistent within ±0.5 wt%). Other ratios such as 80/20 wt%, 95/5 wt%, 97/3 wt% are available on request.

- **Purity**: The total of all impurities listed below does not exceed 100 ppm.
- **Impurities**
  - Al
  - K
  - Sb
  - Bi
  - Na
  - Ti
  - Cr
  - Ni
  - Zn
  - Cu
  - Mg
  - Fe
  - Pb

### Microstructural properties

[SEM Image of a fractured ITO target surface showing a completely densified structure without voids and large porosities as required for high density and low stress targets.]

10 µm

### Application

ITO sputtering targets allow deposition of high quality transparent conductive thin films and are manufactured from selected raw materials with high chemical purity resulting in ceramic tiles/segments with ultra high physical density. Raw materials and final target products have been analyzed by several qualified labs. A variety of compositions and dimensions is available upon request. ITO thin films can be used in a wide range of applications including different types of displays such as TFT-LCDs, OLEDs, PDPs and Touch panels. ITO is also the TCO of choice for various thin film photovoltaic products.

### Dimensions

#### Planar targets

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length/tile</td>
<td>≤ 530 mm (20.87&quot;)</td>
</tr>
<tr>
<td>Width/tile</td>
<td>≤ 375 mm (14.76&quot;)</td>
</tr>
<tr>
<td>Thickness</td>
<td></td>
</tr>
<tr>
<td>Large tiles</td>
<td>≤ 10 mm (0.39&quot;)</td>
</tr>
<tr>
<td>Segment gap</td>
<td>0.38 mm ± 0.13 mm (0.015&quot; ± 0.005&quot;)</td>
</tr>
<tr>
<td>Smaller tiles</td>
<td>≤ 13 mm (0.51&quot;)</td>
</tr>
<tr>
<td>Tolerance for length, width, thickness</td>
<td>± 0.1 mm (± 0.004&quot;)</td>
</tr>
</tbody>
</table>

Larger tiles with specific dimensions can be produced upon customer’s request and targets for basically all planar magnetrons can be assembled from multiple tiles.

#### Rotary targets

Multi-segment assemblies bonded to a Ti backing tube

- **Inner diameter**: 100 – 160 mm (3.94” – 6.30”)
- **Wall thickness**: ≤ 12 mm (0.47”) Standards 6, 9 and 10 mm (0.25", 0.355" and 0.39")
- **Maximum length**: 4000 mm (157.48”)
- **ITO-segment length**: < 200 mm (7.87”)
- **Segment gap**: 0.38 mm ± 0.13 mm (0.015" ± 0.005")

ITO rotary targets are manufactured by bonding ceramic ITO-segments to a Ti backing tube using the most advanced technologies. Backing tubes for ITO targets are provided either by Umicore TFP or by the customer and can be re-used.
Umicore Thin Film Products

Umicore Thin Film Products, a business unit of the Umicore Group, is one of the leading producers of coating materials for physical vapor deposition with more than 50 years of experience in this field.

**Productions Sites**
Umicore Thin Film Products operates production sites in Balzers (Liechtenstein), Providence, RI (USA), Beijing (P.R. of China), Manaus (Brazil) and Pforzheim (Germany). Our worldwide network of local sales offices and customer service centers are located close to our customers, thus ensuring best possible customer proximity.

**Bonding**
Umicore’s production capabilities include bond shop facilities in Balzers (Liechtenstein), Providence, RI (USA) and Hsinchu (Taiwan). Umicore Thin Film Products uses its own proprietary bonding method, based on a flux-free solder technique. Thin film adhesion and diffusion barrier layers are applied to the back of each segment, followed by a temperature controlled metallic solder seal between target and backing plate/tube. The bonding is compliant to accommodate mechanical and thermal stress and bonding integrity is verified by ultrasonic scanning.

**Recycling**
Umicore Thin Film Products offers recycling programs as an added service. Umicore is your preferred partner for a closed recycling loop.

**Bondshops**
- Balzers (Liechtenstein)
- Providence, RI (USA)
- Hsinchu (Taiwan)

**Packaging**
Special packaging is available based on customer requirements. To reduce environmental impact, custom re-usable shipping containers for sputtering targets can be made upon request.

**Quality Assurance**
The Balzers location is certified according to ISO 9001, ISO 14001 and OHSAS 18001 standards. All other production sites are also ISO 9001 and ISO 14001 certified. Documentation, process specifications, traceability, sophisticated analytical methods, and continuously trained employees guarantee the highest and most consistent product reliability.

**Indium metal produced by Umicore**
Please find your local sales partner at:

www.thinfilmproducts.umicore.com