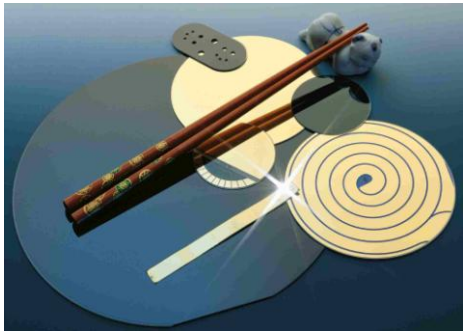
Film deposition

ceraco
ceramic coating

Superconductors



HTS - films

Ceraco fabricates all kinds of $REBa_2Cu_3O_7$ - films (RE = rare earths).

The properties of HTS – films required for certain applications can vary considerably and hence there is no standard HTS – film satisfying all the different specifications. However, ceraco offers different film types tailored for specific applications to allow an easy selection.

The following pages give an overview of technical details which are helpful for making a decision on which film to use.

Each HTS - film leaving our production is thoroughly checked and accompanied by a quality inspection certificate.

and a lot more

Metal oxides with complex composition

Ceraco´s proprietary coating technique has been developed for the deposition of complex, multi-component metal oxide films on large area.

Typical examples are perovskits with special ferroelectric or –magnetic properties or dielectric films for high temperature fuel cells.

Contact us to discuss your desired custom - designed layer architecture and choice of material.

Adhesion, buffers, metalization

With years of experience in thin film coating ceraco has the experts to address all related crucial issues such as adhesion, diffusion and electrical contacts.

Ceraco offers assistance and expertise to solve material related problems, and develops layers to prevent interdiffusion, or metal coatings with extremely low contact resistance.

HTS film types

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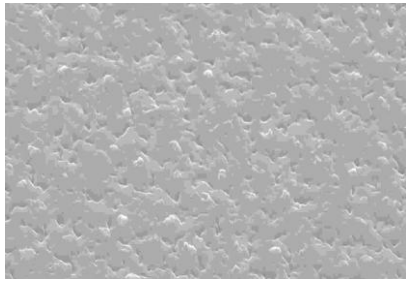
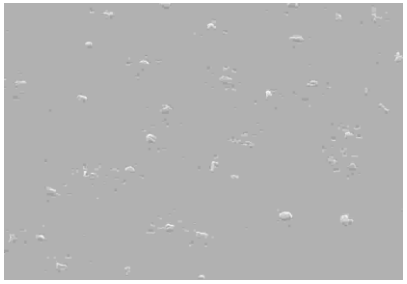
Characteristics			
	M-type Excellent microwave performance, porous surface, enhanced pinning Typical superconducting specs: T_c = 88 K j_c(77K) ≥ 2.5 MA/cm^2 R_s < 300 μΩ (@77K, 10 GHz, 700 nm) Suggested application: Microwave devices, high jc-applications, FCL	**S-type** Smooth matrix, small CuO_x-segregations Typical superconducting specs: T_c = 87 K j_c(77K) ≥ 2 MA/cm^2 R_s < 500 μΩ (@77K, 10 GHz, 700 nm) Suggested application: Squids, micron - linewidth patterning	**E-type** Extremely smooth, no segregations Rms roughness 6-10 nm Typical superconducting specs: T_c ≥ 83 K j_c(77K) ≥ 1 MA/cm^2 Suggested application: Low temperature electronics, multilayers, submicron structures
General warranty No scratches or line defects, No sticking particles or point defects > 50 µm in diameter <2% a-axis per volume	**Warranted specs** T_c > 87 K j_c(77K) > 2 MA/cm^2 R_s < 500 μΩ (@77K, 10 GHz)	**Warranted specs** T_c > 86 K j_c(77K) > 1.5 MA/cm^2	**Warranted specs** T_c > 80 K

Warranty conditions

Guaranteed specifications for films (thickness > 200 nm):

This warranty holds for 6 months after delivery (proper storage in a desiccator) or until processing of the films by the customer

Substrates

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Substrate wafer materials

Characteristics

The most important ingredient for obtaining high quality films are high quality substrates. For this reason we are collaborating only with qualified substrate suppliers.

Substrate materials as listed in the table with their most important parameters are readily available for HTS deposition.

Substrate	Maximum size	Buffer layer	ε□	tan δ (1GHz, 77K)*	Max. film thickness
$LaAlO_3$	3”	CeO_2	23.6	10^{-5}	1.0 μm
MgO	3” or 70x70 mm^2	---	9,7	2×10^{-6}	> 3 μm
YSZ (ZrO_2:Y)	2" mm	Y_2O_3 or CeO_2	27	10^{-3}	1.5 μm
Sapphire	200 mm	CeO_2	11,6/9,4	$< 10^{-6}$	350 nm
$SrTiO_3$	1”	CeO_2	2000	10^{-3}	1.0 μm
$NdGaO_3$	2”	CeO_2	23	3×10^{-4}	1.0 μm
$YAlO_3$	2”	CeO_2	15,5	2×10^{-6}	< 500 nm
LSAT	2”	CeO_2	22,7	2×10^{-4}	1.0 μm

* Values taken from literature

The film thickness limit (here for YBCO) is a consequence of the thermal expansion mismatch between film and substrate. Thicker films tend to relax stresses by cracking.

Substrate sizes

Standard dimensions

We can accommodate practically every substrate size and shape fitting into the deposition area of 22 cm diameter. Standard substrate holders together with the maximum number of substrates per batch of deposition

(batch size in the parenthesis) are listed below:

Circular wafers: 200 mm (1), 150 mm (1), 100 mm (3), 3” (5), 2” (12), 30 mm (30)

Rectangular wafers: 190x100 mm^2 (1), 100x100 mm^2 (1), 75x75 mm^2 (4),
50x50 mm^2 (8), 60x30 mm^2 (10), 40x40 mm^2 (12),
120x10 mm^2 (20), 30x30 mm^2 (20), 20x20 mm^2 (48)

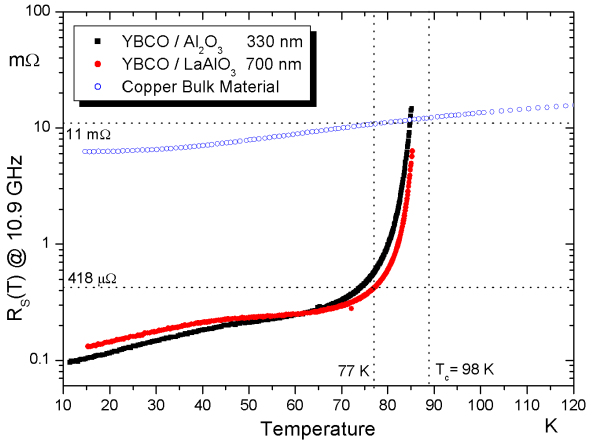
Other dimensions are available on request. In some cases it may be more economic to cut larger wafers into the desired shape after deposition.

Surface resistance

RF resistance

Communication applications require low RF surface resistance

High frequency filters for satellite and cellular communication with extremely sharp skirts and selectivity are realized by HTS - films with low surface resistance.



Temperature dependence

The temperature dependence of the microwave surface resistance at 10.9 GHz is depicted on the left.

Two typical M-type YBCO films of different thickness are shown on $LaAlO_3$ (700 nm) and sapphire (330 nm).

The R_S of copper is shown for comparison.