

THIN FILM MATERIALS CATALOG 2011

SPUTTERING TARGET, MOCVD PRECURSOR

Toshima Manufacturing Co.,Ltd.

Creating Impressive Technology

TOSHIMA Manufacturing

TOSHIMA supplies all kinds of Material Source for thin films.

Materials System Division of the Toshima Manufacturing Co., Ltd. is always searching ways to contribute to moving and advancing Present Society in the field of New Material development.

Various kinds of different methods need various forms of the raw materials, in the form such as Sputtering Targets, MOCVD precursors, and many other suitable forms. Materials System Division is able to produce and provide those materials with the same quality starting from R & D level to the mass Production level. Here is the material that you have been looking for.

Mission

As an innovative material supplier, we are proud of the philosophy.

- 1. Be flexible to correspond to changes
- 2. Act quickly and efficiently based on the customer’s view
- 3. Contribute to the quality improvement that brings the world’s progress

Toshima Manufacturing Co., Ltd. Materials System Division contributes to the society through the material development matching the changing the world's needs.

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Magnetic Recording and Device Materials

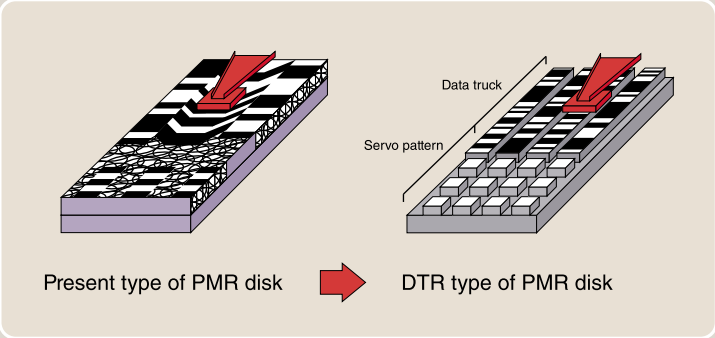
Magnetic recording material is always progressing such as HAMR(Heat Assisted Magnetic Recording) Media and BPM(Bit Patterned Media). We develop sputtering targets not only for advanced magnetic recording media but also for Magneto Resistive device and MRAM.

Sputtering Target

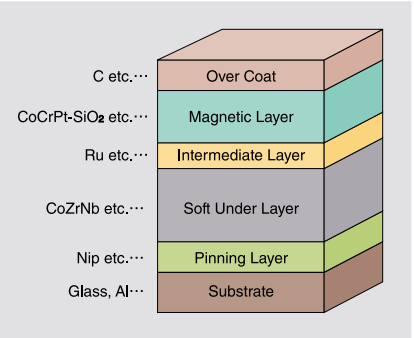
Recording layer material	FePt	FePt-SiO ₂	FePtCu-C	CCP
Under layer material	Ru	RuCo	Ru-SiO ₂	Ru-TiO ₂
Intermediate layer material	NiW	CuCr	CuTi	FeTa
Embedded layer material	TiAlW	Cr	Al ₂ O ₃	SiO ₂
Protective layer material	C	C-Co	CrN	SiC _x

If any other inquiries except above, please free to contact.

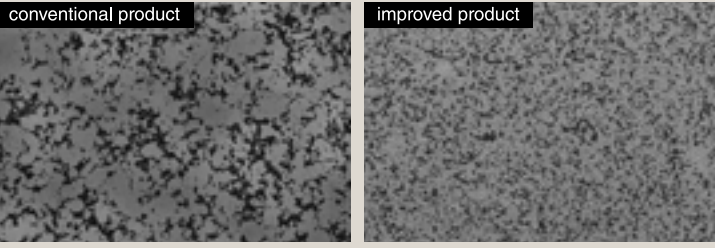
Schematic diagrams of DTR



Structure of PMR



SEM images of CoPtCr granular targets



CoPtCr granular target

Ferroelectrics & Electrode Materials

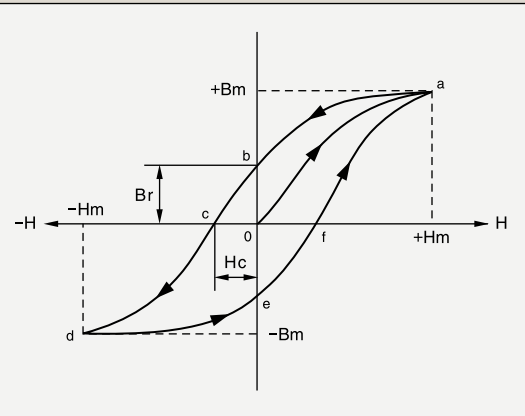
Ferroelectric films, which are typically characterized by their piezoelectricity, are applied to various devices such as FeRAMs, Sensors and Inkjet heads. We provide high density and high quality sputtering targets, MOD coating solutions and MOCVD precursors to widely meet with customers' needs.

Sputtering Target, PLD Target & Powder

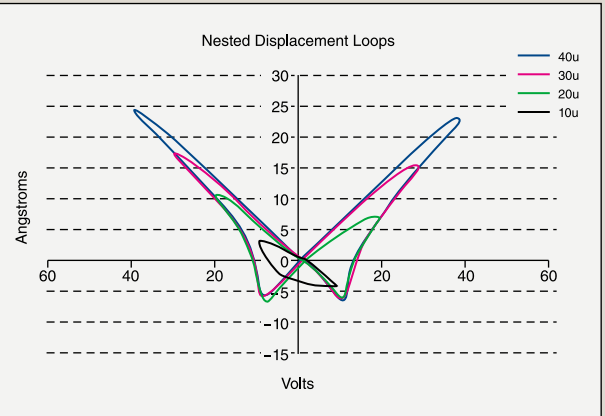
Ferroelectric material	P(L)ZT	SBT	KN/KT	BiNaTiO	BiFeO ₃	
Gate insulator material	HfO ₂	HfSiO(N)	HfO ₂ -Al ₂ O ₃	La ₂ O ₃	La ₂ O ₃ -Al ₂ O ₃	
Electrode material	Pt	Ir	IrO ₂	SrRuO ₃	LaNiO ₃	TiN

If any other inquiries except above, please free to contact.

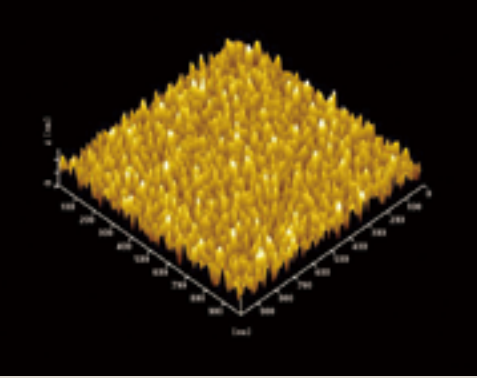
B-H hysteresis loop



Nested Butterfly Loops



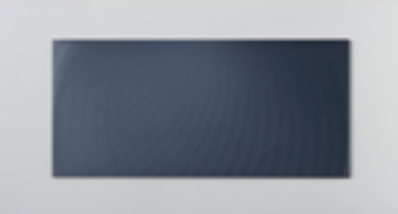
AFM image of the surface of ferroelectric thin film



LaNiO₃ target



PZT target



Pb(Zr,Ti)O_{3-x} target

Oxide Semiconductor & "TCO" Materials

Oxide semiconductors have been being applied to various purposes. IGZO(InGaZnO) is realized as TFT for flat panel displays thanks to superior carrier mobility.

Sputtering Target

Oxide semiconductor

InGaZnO

CuAlO₂

ZnO

SnO

SrCu₂O₂

Cu₂O

NiO

CuCrO₂

ZnIr₂O₄

TCO material

In₂O₃

ZnO

TiO₂

SnO₂

If any other inquiries except above, please free to contact.

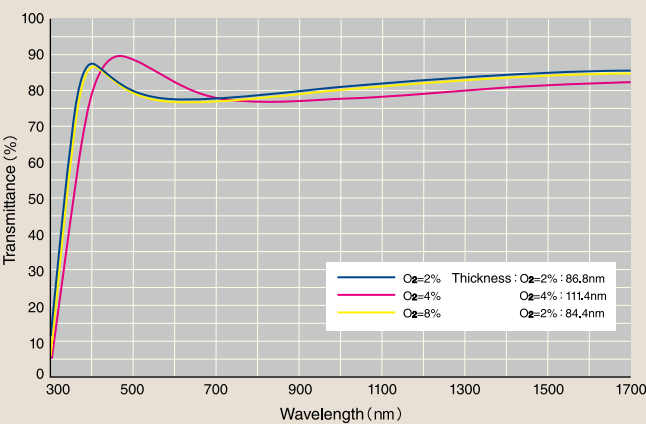
IGZO target

Character of our IGZO target

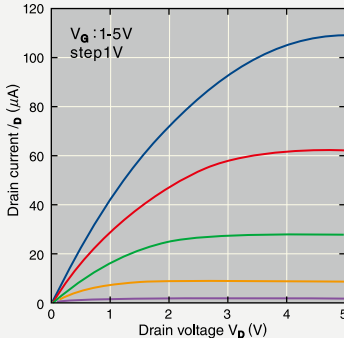
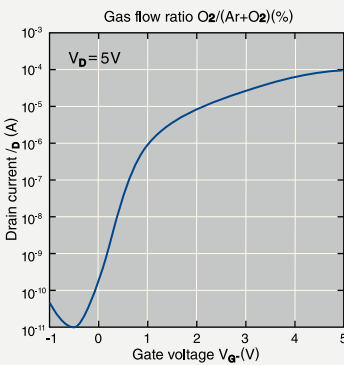
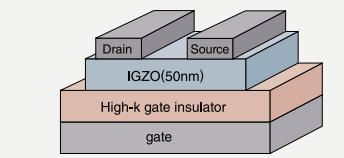
- Single phase
- High density (95% up)
- Conductive for DC sputtering (10⁻²~10⁻³Ω cm)
- Various composition (2-2-1-7 etc.) can be produced.



Transmittance of IGZO thin films



Properties of IGZO TFT



Mobility : 16.6cm²/Vs, V_{th}=0.9 V, on/off ratio = 10⁷

*Cooperation with Arakawa laboratory of Research Center for Advanced Science and Technology, University of Tokyo

Optical & Optoelectronics Materials

The needs against the material for transparent electrodes, reflective films and anti-Reflective(AR) films are widely increasing recently. We can provide not only particularly customized material for R & D but also AR Coating material for mass production.

Sputtering Target

Anti-reflective film material

MgF₂

Nb₂O_x

Al₂O₃

Ta₂O₅

TiO₂/SiO₂

Reflective film material

Ag-alloy

Al-alloy

Material widely use for LED

ITO

TiO₂:Nb

GaN

Ag-alloy

ATO

Material for Optical media

CuSi

GeSbTe

If any other inquiries except above, please free to contact.

Conductive Nb₂O_x target

Character of our target

- Possible by DC-sputtering
- 3 times higher in sputtering rate over Nb metal.
- 5 times higher power can be applied over Nb₂O₅.
- High-n similar to TiO₂.

Target quality

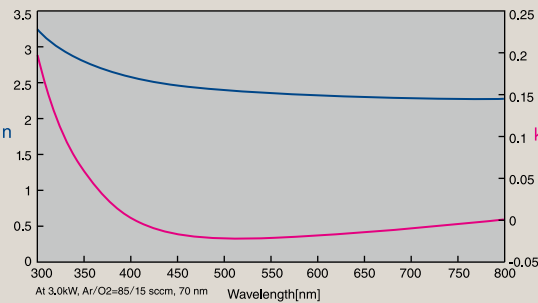
- Composition : Nb₁₈O₂₉→Nb₂O_{4.83}
- Purity : 99.9% up
- Density : Approx 4.5g/cm³ (Nb₂O₅:4.47g/cm³)
- Thermal conductivity : 4.0 (W/mk)
- Coefficient of thermal expansion : 2.0 (x 10⁻⁶/K)
- Bulk resistivity : < 3x10⁻² (Ω cm)



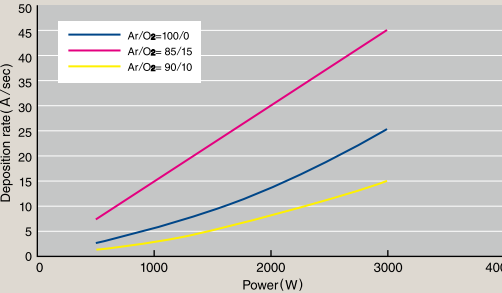
Sputtered Nb₂O_x target

Optical performance

Target Size	Applied power	Ar/O ₂ ratio	Thickness	n (Refractive index)				k (Damping factor)			
				405nm	550nm	635nm	1550nm	405nm	550nm	635nm	1550nm
φ 200	PulseDC 3kW	85 /15	70 nm	2.57	2.35	2.305	2.22	1.29E-03	1.97E-02	1.38E-02	2.54E-12



Deposition rate



Battery & Energy Materials

Battery and energy industries are the most attractive industries now. Toshima provides many different materials including electrode and electrolyte for Lithium ion secondary batteries, fuel cells, thin film solar cell. Powder and MOD coating solutions are also available. Toshima contributes to customers R & D manufacturing high quality sintered and Junction bodies.

Sputtering Target, Powder, Paste

Li-ion secondary battery material

Positive electrode	LiCoO ₂	LiMn ₂ O ₄	LiCo _{1/3} Ni _{1/3} Mn _{1/3} O ₂	LiFePO ₄
Negative electrode	Si-alloy	Nb ₂ O _x	Li ₄ Ti ₅ O ₁₂	NbTiO _x
Electrolyte	Li ₃ PO ₄	Li ₆ BaLa ₂ Ta ₂ O ₁₂	Li ₇ La ₃ Zr ₂ O ₁₂	

Thin film solar cell material

Light-absorbing layer	CuGa	CuGaIn	CuZnSn	CuInTe ₂
Buffer layer	In ₂ S ₃	ZnS	ZnO-MgO	ZnO
Transparent electrode	AZO	BZO	GZO	TiO ₂ :Nb
Anti-refractive layer	MgF ₂	SiN	TiO ₂	

Thermoelectric conversion material

BiTe	BiSbTe	MgSi	MnSi	CoSb
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If any other inquiries except above, please free to contact.

Conductive "ZnO"

Character of our target

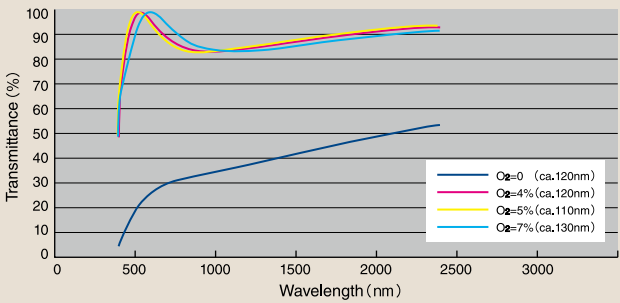
- Possible by DC-sputtering
- Oxygen deficient type (no doping)
- Color : Close to black.

Target quality

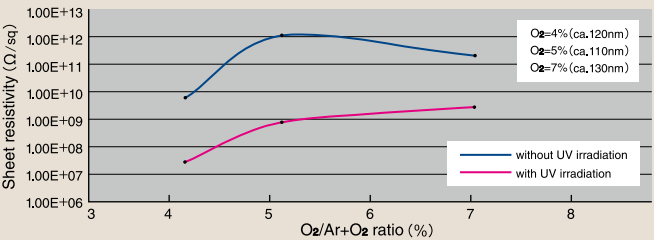
- Resistivity : 2 x 10⁻² (Ω cm)
- Density : 98% up (ZnO : 5.68g/cm³)



Dependence of transmittance on oxygen concentration



Dependence of resistivity on oxygen concentration (O2/Ar+O2 ratio)



Superconductor

Further possibility for usage superconductor has been expanding to be materialized soon or later. We believe, we can be a one of your good collaborator to develop your superconducting material.

Sputtering Target, MOCVD Precursor, Powder, Paste

Superconducting material

YBCO	GdBCO	PrBCO	BSCCO
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Interfacial/buffer layer material

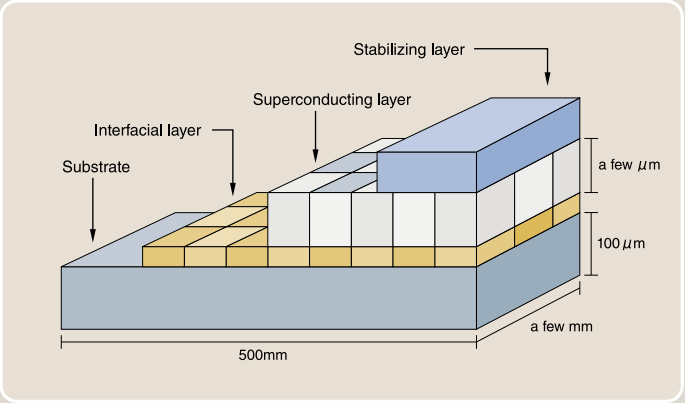
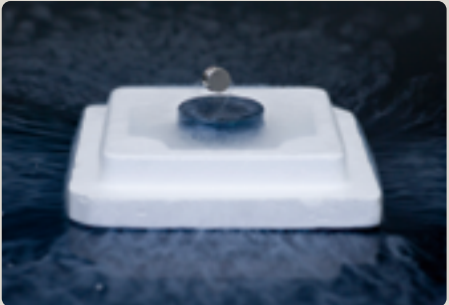
CeO ₂	Gd ₂ Zr ₂ O ₇	Ce	LaMnO ₃
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Under layer

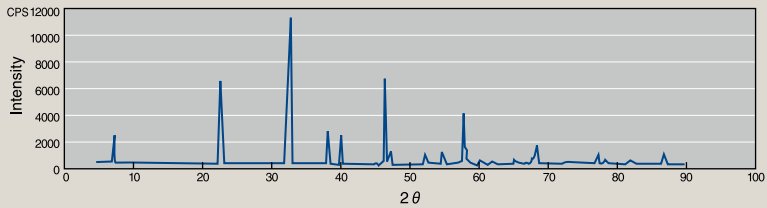
Ni-alloy	MgO	SrTiO ₃	Al ₂ O ₃	Mg
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If any other inquiries except above, please free to contact.

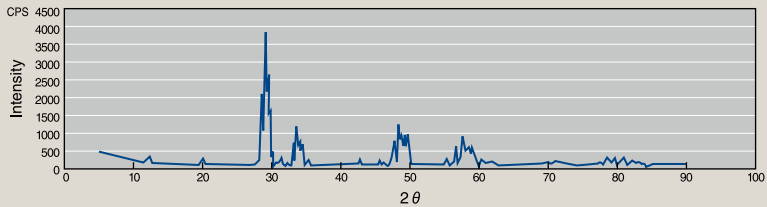
Structure of superconducting tape



XRD pattern of Gd123



XRD pattern of Gd2Zr2O7



MOCVD Precursors

Toshima has been developing various types of MOCVD precursors to comply with customer's needs. Especially, we focus on MOCVD precursors used for oxides. We can provide from minimum unit of 5 grams with not only a glass ampoule but also stainless steel cylinder.

Precursors

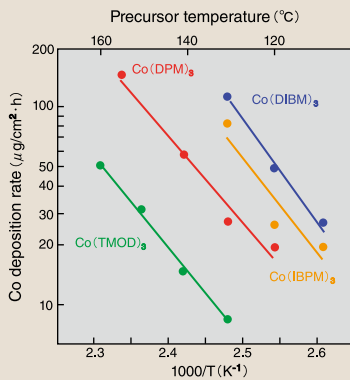
Available line of elements

H																			He
Li	Be											B	C	N	O	F		Ne	
Na	Mg											Al	Si	P	S	Cl		Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br		Kr	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I		Xe	
Cs	Ba	Ln	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At		Rn	
Fr	Ra																		
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu			

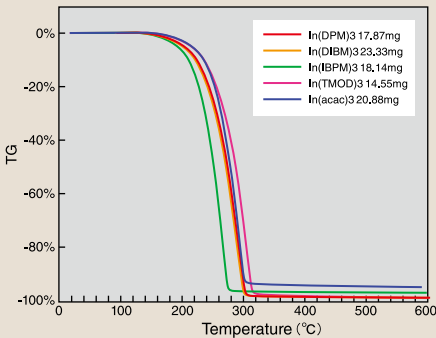
■ Melting point and solubility of Zn complexes

Materials	m.p.(°C)	Solubility		
		Toluene	Butyl Acetate	THF
Zn(TMODO) ₂	48	S	A	S
Zn(DPM) ₂	141	A	B	A
Zn(IBPM) ₂	<20	A	A	A
Zn(DIBM) ₂	80	S	A	S
Zn(acac) ₂	138	G	G	G

S: >1mol/l A: 1-0.5mol/l B: 0.5-0.33mol/l C: 0.33-0.25mol/l D: 0.25-0.2mol/l
E: 0.2-0.15mol/l F: 0.15-0.1mol/l G: <0.1mol/l

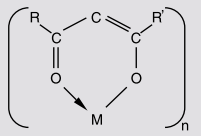


Dependence of Co deposition rate on precursor temperature



Comparison of TG curves of In complexes in Ar flow atmosphere

β-diketonato complexes



DPM: R=R'=C(CH₃)₃
DIBM: R=R'=CH(CH₃)₂
IBPM: R=C(CH₃)₃, R'=CH(CH₃)₂
TMODO: R=C(CH₃)₃, R'=C(CH₃)₂C₂H₅

MOD Coating Solutions

We can provide wide range of MOD solutions, and is its composition and concentration according to customers' needs. We always challenge in making something new experimental material for Lab, Institute.

Solutions

Oxide semiconductor and conductive oxide material

IGZO	ZnO	In ₂ O ₃	SnO ₂	NiO
TiO ₂	LaNiO ₃	RuO ₂		

Ferroelectric material

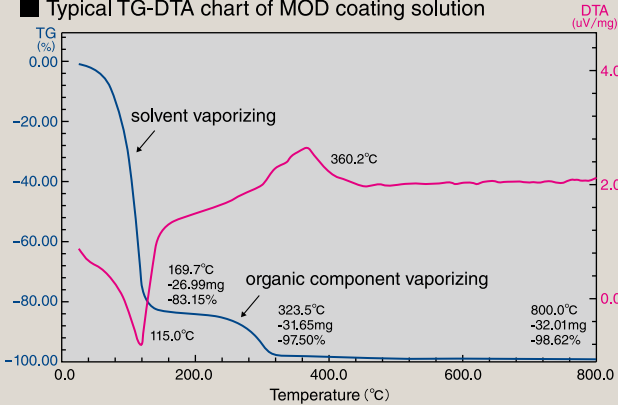
PZT	SBT	BFO	KN/KT	Sr ₂ Nb[Ta] ₂ O ₇
BST	BaTiO ₃	LiNbO ₃		

Others

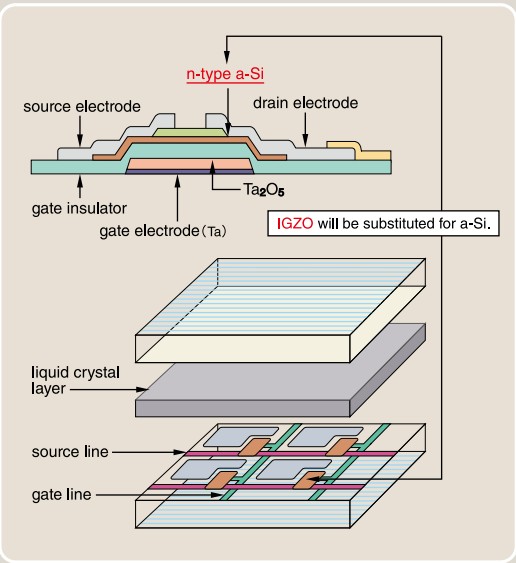
LSM	LSC	PCMO	LiLaZrO	SrTiO ₃
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If any other inquiries except above, please free to contact.

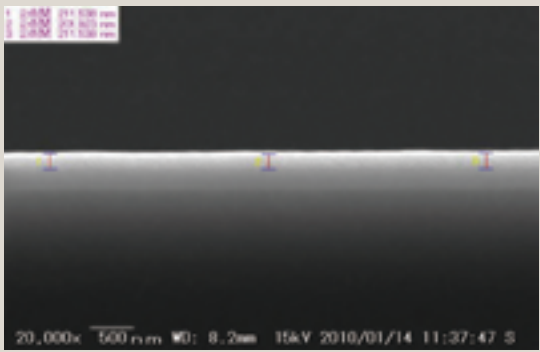
■ Typical TG-DTA chart of MOD coating solution



■ Standard TFT's structure using IGZO



■ SEM image of a spincoated film



Deposition conditions

2000rpm 20sec →150°C 5min
→450°C 15min


• Thickness : ca.40nm/1 spin-coating



Analyzing

Our skillful engineers analyze environmental and drainage water measurement as well as ordinal material analysis. For the information, we are registered as a "Certified Environmental Survey Measurement Services".

Items of analyses




Instrument

Inductively coupled plasma - Atomic emission spectroscopy (ICP-AES)

Type

Seiko Instruments Inc. SPS-3000




Instrument

X-ray diffractometer (XRD)

Type

Rigaku TTR II




Instrument

X-ray fluorescence spectrometer (XRF)

Type

SHIMADZU EDX-720




Instrument

Laser diffraction particle size distribution monitor

Type

NIKKISO Microtrac MT3000




Instrument

Scanning electron microscope (SEM)

Type

KEYENCE VE-7800




Instrument

Spectrophotometer

Type

HITACHI U-1900

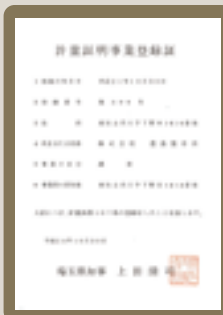


Instrument

Thermogravimetry and Differential thermal analysis (TG-DTA)

Type

MAC Science TG-DTA 2020S
Bruker AXS TG-DTA 2020SA



Our survey measurement service is certified by Saitama prefecture in Japan.

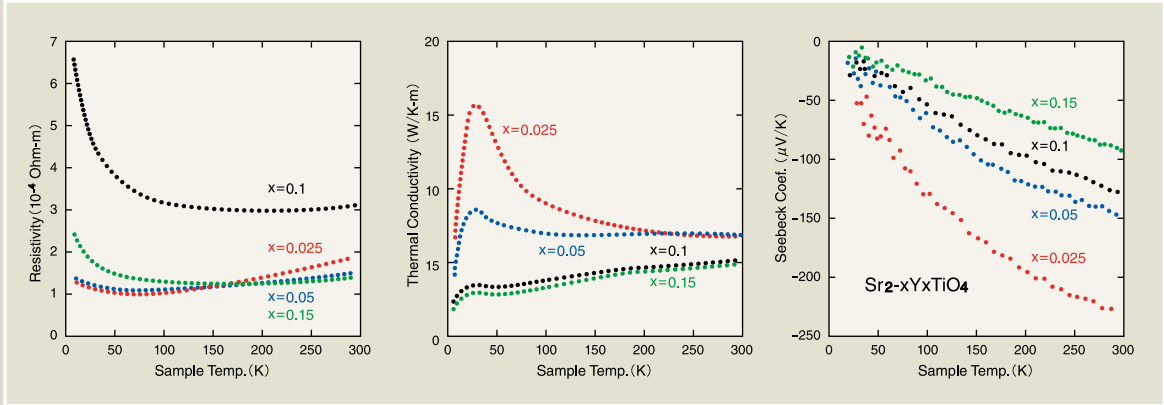
Outsourcing

We keep in development of some new thin film materials for sputtering target, grain, and precursor to stimulate the needs of researchers.

Outsourcing : Material development

Toshima supports new material development for whole thin film products such as powders, sputtering targets, MOCVD precursors and MOD solutions. In case you need us to contract Non-Disclosure Agreement for developing new materials, we will follow to your requirement without any problems.

Thermoelectric conversion properties (collaboration with Advanced Industrial Science and Technology)



Outsourcing: Coating process



By our sputtering, customers can outsource film growth process. Thin films after coating can be analyzed and evaluated by XRD, spectrophotometer and so on.

Facilities

We, Toshima manufacturing company produce several kinds of materials mainly for thin-film in one continuous production. You can refer the below equipments with which we can produce quality products.

Facilities for manufacturing sputtering targets

Following is the machines, equipments for respective production processes.



1 Powdering



2 Calcination/Combustion



3 Sintering



4 Machining



5 Checking



6 Bonding

Facilities for producing MOCVD precursors and MOD coating solutions

Following is the equipments for production.



Company

Company Name	Toshima Manufacturing Company Limited
Established	May 1945
Capital Stock	99 million yen
President	Kentaro Kimoto
Employees	181 as of March 2011
Business Segments	<ul style="list-style-type: none">• Production and sales of materials for electronics• Cold-forging and pressing (Machining and Assembly)• Production and sales of toys for riding
Headquarter's location	1414 Shimonomoto, Higashimatsuyama, Saitama 355-0036, Japan
Site area	24,952m ²
Building area	11,418m ²
Main financing banks	Towa Bank Higashimatsuyama branch Musashino Bank Higashimatsuyama branch
Associated Company	Nippon Ferro Technology Corporation



History

May 1945	Toshima Kokuki Company was established in Toshima ward in Tokyo by Sokichi Kimoto.
Oct 1949	Changed the corporate name to Toshima Manufacturing Company.
Dec 1971	Moved to Higashimatsuyama in Saitama prefecture.
Nov 1982	Daisaku Kimoto became the president.
Sep 1993	Established Materials System Division and began to produce sputtering targets.
Apr 1999	Established MOCVD section.
Jul 2000	Certified ISO9001.
Oct 2005	Certified KES environmental management system.
Sep 2006	New factory for mass production was operated.
Jan 2011	Kentaro Kimoto became the president.



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