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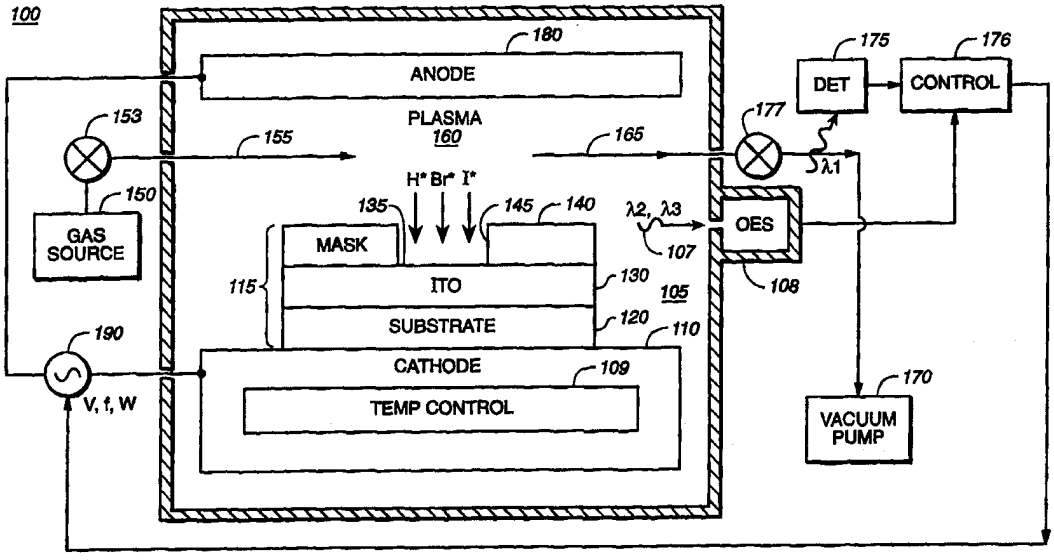
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(54) Title: DRY-ETCHING OF INDIUM AND TIN OXIDES



(57) Abstract

An etch method includes providing a layer made of a material selected from the group consisting of an indium oxide (InO), a tin oxide (SnO), a mixture of indium and tin oxides, a compound of indium and of tin and of oxygen having the general formulation: $In_xSn_yO_z$ where z is substantially greater than zero but less than 100 % and where the sum x+y fills the remainder of the 100 %, and a mixture of the preceding ones of the group members. A reactive gas including hydrogen bromide (HBr) and hydrogen iodide (HI) is supplied to a vicinity of the material layer. Also, an electric field is supplied to react the supplied reactive gas with the material layer so as to form volatile byproducts of reactive gas and the material layer.

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DRY-ETCHING OF INDIUM AND TIN OXIDES

Related Applications

This application is related to the applications listed below which are being filed on the same date and assigned to the same assignee as the present invention. The applications listed below are incorporated herein by reference in their entirety: (1) U.S. Serial No. 08/881,950, entitled "DRY-ETCHING OF INDIUM AND TIN OXIDES," by Jie Chen and Yuen-Kui Wong; and (2) U.S. Serial No. 08/881,324, entitled "DRY-ETCHING OF THIN FILM LAYERS," by Jie Chen, Haruhiro Goto, Marc Michael Kollrack, Carl Sorensen, John White, Yuen-Kui Wong and Tzy-Chung Wu.

Background of the Invention

The invention is generally directed to dry etching of indium and tin oxides.

The manufacture of a flat glass panel display, for example, typically begins with a clean glass substrate. Transistors are formed on the flat panel using film deposition and selective etching techniques. Sequential deposition, photo-lithography and selective etching of film layers on the substrate create individual transistors on the substrate. These devices, as well as metallic inter-connections, liquid crystal cells and other devices formed on the substrate are then used to create active matrix display screens on the substrate to create a flat panel display in which display states are electrically created in the individual pixels.

Opto-electronic devices such as liquid crystal displays (LCD's), charge coupled sensor devices (CCD's) and the like often include thin-film transparent electrodes disposed over a light transmitting or light receiving element.

The transparent electrodes are typically composed of an oxide of indium (InO) or an oxide of tin (SnO) or a mixture of these oxides or a compound having the general formulation: $In_xSn_yO_z$, where the z factor is greater than zero but less than 100%. The formulation, $In_xSn_yO_z$ is commonly known in the art as ITO.

During manufacture, a thin-film of the material making up the transparent electrodes is deposited on a substrate. The thin-film is thereafter selectively etched so as to remove pre-specified portions and thereby define a desired wiring pattern.

It is generally desirable in mass-production situations to etch the transparent-electrode thin-film in such a way that the etching does not significantly damage any underlying structures.

It is also generally desirable to perform the etch as quickly as possible and with as few steps as necessary in order to reduce mass-production complexity and costs.

Until recently, one common method for selectively etching ITO was to wet etch through a photolithographically patterned mask using chemically-reactive aqueous agents such as ferric chloride ($FeCL_3$).

Wet etching, however, has drawbacks. It tends to leave a liquid residue, which often must be removed prior to further processing. The removal of residue complicates the overall process and increases costs.

Another drawback of wet etching is that its material removal rate tends to be highly sensitive to temperature variations. Tight temperature control, which also complicates the overall process and increases costs, is needed to compensate and prevent over or under etching. "Under etching" refers to the condition where the transparent-electrode thin-film is not etched through thoroughly and undesired shorts appear in the resultant conductor patter. "Over etching" refers to the condition

where the transparent-electrode thin-film is etched through thoroughly and undesired etching of the underlying substrate begins and/or time and resources are wasted in trying to etch to a depth beyond that needed.

Yet a further drawback of wet etching is that it is isotropic. Over etching may lead to undesired undercutting beneath the etch mask. The undercutting may be so extensive that it leads to unintended open circuits in the conductor pattern.

More recently, attempts have been made to overcome the problems of wet etching by dry etching the material layer of the thin-film transparent electrodes with an anisotropic reactive plasma.

Summary of the Invention

In general, in one aspect, the invention features an etch method which includes providing a layer made of a material selected from the group consisting of an indium oxide (InO), a tin oxide (SnO), a mixture of indium and tin oxides, a compound of indium and of tin and of oxygen having the general formulation $In_xSn_yO_z$ where z is substantially greater than zero but less than 100% and where the sum x+y fills the remainder of the 100%, and a mixture of the preceding ones of the group members. A reactive gas including hydrogen bromide (HBr) and hydrogen iodide (HI) is supplied to a vicinity of the material layer. Also, an electric field is supplied to react the supplied reactive gas with the material layer so as to form volatile byproducts of reactive gas and the material layer.

In various implementations, the invention includes one or more the following features. The reactive gas can include various mixtures of HBr and HI. For example, the reactive gas can include approximately fifty percent hydrogen bromide and approximately fifty percent hydrogen iodide.

The reactive gas can be supplied at a pressure at least as low as approximately 60 milliTorr. For example, a pressure of approximately 15 milliTorr can be used.

In some implementations, a mask layer can provided over the material layer. The mask layer can have one or more apertures defined through the mask layer for exposing corresponding surface portions of the material layer to products of the reactive gas and the applied electric field.

A substrate can be provided below the material layer. A determination can then be made as to when the etch process etches through the material layer to the substrate, and the etch process can be halted at or about the time it is determined that the etch process has etched through the material layer to the substrate.

Respective amounts of HBr and HI can be provided in the reactive gas to control the uniformity of etching of a surface of the material layer.

Respective amounts of HBr and HI can also be provided in the reactive gas to control the size of a taper angle formed with respect to an etched portion of the material layer. For example, the respective amounts of HBr and HI can be selected to achieve a taper angle in the range from approximately 30 degrees to approximately 72 degrees or higher. In addition, respective amounts of HBr and HI can be provided in the reactive gas to control the etch rate of the material layer. Moreover, respective amounts of HBr and HI can be provided in the reactive gas to control the selectivity of etching of the material layer compared to a substrate.

In various implementations, the invention features one or more of the following advantages. By using a mixture of HI and HBr, it is possible to achieve an etch whose uniformity is better than the uniformity which results from using either HBr or HI alone. The improved

uniformity can be used for relatively large surface areas, such as those typically used in flat panel displays. Additionally, the relative amounts of HBr and HI in the reactive gas can be selected to control the taper angle of the etched material depending upon the subsequent processing which may be required. Using a mixture of HBr and HI as the reactive gas can provide both a relatively highly selective etch as well as a relatively residue-free etch.

Brief Description of the Drawings

FIG. 1 is a cross-sectional schematic of a reactive ion etch (RIE) system for carrying out a dry etch process in accordance with the invention.

FIG. 2 illustrates a taper angle that results from etching a transparent-electrode material layer.

Description of the Preferred Embodiments

Fig. 1 schematically shows in cross-section a reactive ion etch (RIE) system 100. A more detailed mechanical description of the basic etching apparatus may be found in Serial No. 08/273,382, filed July 7, 1994 by Wong et al., entitled "METHOD AND APPARATUS FOR ETCHING FILM LAYERS ON LARGE SUBSTRATE," assigned to the assignee of the present invention, and incorporated herein by reference in its entirety.

System 100 includes a substrate-supporting cathode 110 that is spaced-apart from an opposed anode 180 within a low-pressure chamber 105. The anode 180 may be a discrete element as shown or it may be defined by one or more of the inner walls of the etch chamber 105 rather than being a separate element. In one implementation, the inner walls of the chamber define the anode, and the cathode is placed centrally within the chamber so that multiple faces of the cathode oppose corresponding inner walls of the chamber. The latter implementation allows

for the simultaneous etch of two or more workpieces in one chamber.

A radio frequency (RF) generator 190 is coupled electrically to the cathode 110 and anode 180 for producing an RF field between the opposed faces of the cathode and anode. The RF field may be of a single frequency or multiple frequencies. A combination of approximately 13.56 megahertz (MHz) for plasma creation and approximately 400 kilohertz (kHz) for ion acceleration can be used.

A gas supply means 150, which can include a gas container or gas tank, is operatively coupled to the low-pressure chamber 105 for supplying a reactive gas 155 into the chamber 105. The reactive gas 155 may include a mixture of hydrogen-bromide (HBr) and hydrogen-iodide (HI). A flow-rate control means 153, such as a valve, is provided for regulating the inflow rate of the reactive gas 155 so as to maintain a desired level of inflow (e.g., 100 sccm, which is the flow of gas which fills up per minute a volume of 100 cc to a pressure of 1 atmosphere at 0 °C). Usually there is no inert carrier gas such as argon, helium or nitrogen in the input gas stream because more work is needed to exhaust this additional material to maintain low pressure. However, one may use one or more such inert gases as a carrier for the reactive gas 155 if desired.

The flow rate of the supplied reactive gas 155 should be approximately 100 to 200 sccm, although higher or lower flow rates may be desirable in certain implementations.

A pressure regulator 177 is provided along the exhaust path of a vacuum pump 170 for maintaining a desired pressure level within chamber 105. The pressure level should be at least as low as approximately 60 mTorr, although higher pressure levels may be appropriate

in certain applications. Pressure levels at least as low as approximately 30 mTorr are desirable. In some applications, a pressure level of approximately 15 mTorr provides a particularly uniform etch across the surface of the etched material. In general, it is desirable to maintain the ratio of vapor pressure to chamber pressure at least as high as 10^5.

A workpiece 115, which has a transparent-electrode material layer 130 to be etched, is mounted on the cathode 110. The workpiece 115 can include a substrate 120 onto which the transparent-electrode material layer 130 is deposited. The substrate 120 may be composed of one or more layers of materials such as glass (SiO_2), silicon nitride (Si_3N_4), amorphous silicon (a-Si), poly or mono-crystalline silicon (p-Si or Si), or other materials as may be suitable for a specific opto-electronic application.

The transparent-electrode material layer 130 can be a thin-film having a thickness of 1500 angstroms or less and comprising ITO, an indium oxide, a tin oxide, or a mixture of these oxides.

A pre-patterned mask 140 that has been formed by photolithography or other suitable techniques is provided about the material layer 130 which is to be etched. The mask 140 has an aperture 145 defined therethrough for exposing a surface portion 135 of the transparent-electrode material layer 130. Unexposed portions of material layer 130 are protected from etching by the material of the mask 140. The mask 140 can be composed of materials such as photoresist deposited to a thickness of 1.5 microns (μm).

The chamber 105 is sealed to maintain pressures at least as low as 60 mTorr in the vicinity of the workpiece 115. The vacuum pump 170 is coupled to the low-pressure chamber 105 for evacuating exhaust gases 165 from the

chamber 105 and for maintaining a desired low pressure within the chamber 105.

The RF generator 190 is activated by the etch-controller 176 to provide an oscillating electric field between the cathode 110 and anode 180 for etching through the exposed portion of material layer 130 in a single step and stopping after etch-through has been achieved.

The frequency (f) of the generated RF field is preferably in the range of approximately 400 kHz to 13.56 MHz. If desired, the generated RF field may have a combination of multiple frequencies such as both 13.56 MHz and 400 kHz and these combined multiple frequencies may be developed by separate oscillators. The lower frequency field is often developed so as to predominate in the vicinity of the substrate-supporting cathode 110 and is referred to as the pedestal RF. The higher frequency field is often developed so as to predominate in the vicinity of the plasma above the workpiece 115 and is referred to as the plasma RF.

The power density (W) of the applied RF field should be at least approximately 0.5 watt per centimeter squared (0.5 W/cm^2) as measured relative to the exposed surface area 135 of material layer 130. In certain implementations, a power density of at least approximately 2 W/cm^2 is desirable, although higher or lower power densities are appropriate in other situations. In general, the etch rate tends to increase at higher power densities. However, at higher power densities, photoresist can become more difficult to remove following the dry etch.

The intensity (volts/cm) of the RF field is sufficiently large to disassociate the next-described reactive gas 155 into atomic constituents (free radicals). In one embodiment, field intensity in the

range of 300 to 800 volts/cm is created in the vicinity of the exposed surface portion 135 of material layer 130.

The gas source 150 supplies a steady stream of a reactive gas 155 including or consisting of a mixture of hydrogen bromide (HBr) and hydrogen iodide (HI). In one implementation, for example, the gas consists essentially of fifty percent HBr and fifty percent HI by volume.

A temperature controller 109, such as a fluid-cooled heat exchanger, is coupled to the cathode 110 to maintain the temperature of the cathode in the range of approximately 5 to 80 °C. The temperature of the substrate 120 should be maintained at approximately 120 °C or less, and preferably at 100 °C or less to prevent damage to the films on the substrate 120. The temperature of the substrate 120 is determined by thermal transfer through the cathode 110 to the temperature controller 109. The temperature of the plasma 160 that forms in the vicinity of the surface portion 135 can be significantly higher and tends to be sporadic as the plasma fluctuates.

A spectroscopic analyzer 175 is provided along the exhaust path of vacuum pump 170 for optically scanning the exhaust gases 165, analyzing the results and thereby determining the chemical composition of the exhaust gases 165. The spectroscopic analyzer 175 is designed to distinguish between exhaust gases 165 that do or do not contain one or more compounds in the by-product group consisting of: water vapor (H_2O), indium iodides (In_xI_y), tin iodides (Sn_xI_y), indium bromides (In_xBr_y), and tin bromides (Sn_xBr_y) and tin hydrides (Sn_xH_y).

The following TABLE-1 lists some of the chemical reactions that are believed to occur between the freed constituents H^*, Br^* and I^* and In, Sn and O to produce volatile byproducts.

TABLE-1

1st Reactant	2nd Reactant	Volatile By-products
Br^*	In	InBr, $InBr_2$, $InBr_3$
Br^*	Sn	$SnBr_4$
I^*	In	InI, InI_2, InI_3
I^*	Sn	SnI_4
H^*	Sn	SnH_4
H^*	O	H_2O

In one implementation, the spectroscopic analyzer 175 includes an optical detector that is sensitive in the visible light range of $\lambda 1$ equal to approximately 450 to 452 nanometers.

The spectroscopic analyzer 175 is coupled to an etch-controller 176 that turns off the RF generator 190 and thereby halts the etch process when the analyzer 175 indicates that effective etch-through has been achieved.

The term 'effective etch-through' is used here to mean the condition when etching has progressed sufficiently far into the transparent-electrode layer so that a useable wiring pattern is created in the transparent-electrode layer without leaving behind undesired shorts or low resistance paths between conductors of that layer that are to be electrically isolated from one another.

A second spectroscopic detector, referred to as an OES (Optical Emission Spectroscope) 108, can be installed approximately in line with the workpiece surface so as to detect plasma induced light emission $\lambda 2$ of indium (In) or tin (Sn) approximately in the plane 107 of a surface portion 135. The OES 108 is coupled to the etch-controller 176 so as to turn off the RF generator 190 and thereby halt the etch process when effective etch-through is indicated to have been reached by an empirically-

determined reduction in λ2 emissions of In or Sn in the plane 107.

The OES 108 has a faster response time than the exhaust spectroscopic analyzer 175 because the OES 108 does not wait for exhaust gases to reach it. When used in combination with the OES 108, the exhaust spectroscopic analyzer 175 may be used to verify readings obtained from the OES 108 to assure that the OES 108 is operating correctly before plasma shut-off occurs.

Another way that the time point of effective etch-through of material layer 130 can be determined is by looking for peaks in plasma induced light emission λ3 of hydrogen (H), bromine (Br) and/or iodine (I) approximately in the plane 107 of the surface portion 135. While there is still In or Sn available for reaction with and consumption of H, Br and/or I in the vicinity surface portion 135, the concentration of H, Br and/or I remains diminished in this vicinity. However, once effective etch-through has been achieved, there is a substantial decrease in the In or Sn available for reaction with H, Br and/or I, and a concentration peak shows in the wavelengths of H, Br and/or I. The RF generator 190 can be turned off in response to the detection of such a peak in the monitored wavelengths of H, Br and/or I to thereby halt the etch process at the point of etch-through.

Alternately, the combination of H, Br and/or I emission peaks, and In and/or Sn emission minima may be used to determine the time point for turning off RF generator 190.

In yet another variation, if the material of the substrate 120 is susceptible to etching by H, Br and/or I radicals, then OES 108 can also be used to detect plasma-induced light emission by the released constituents of the substrate 120 as etch-through is achieved. The

detection of this event may also be used to determine the appropriate time to turn off the RF generator 190.

FIG. 2 illustrates the workpiece 115 after the transparent-electrode material layer 130 has been etched using a reactive gas 155 consisting essentially of HBr and HI. The etched sidewalls 132 of the ITO layer 130 form a taper angle α with the surface of the substrate 120 as shown in FIG. 2. The taper angle can be varied from as low as approximately 30 degrees to as high as approximately 72 degrees.

TABLE-2 shows experimental results obtained for the case where the material layer 130 consists essentially of ITO. The sample size was approximately 360 mm by 465 mm. The RF generator 190 was set to a single frequency of 13.56 MHz for both the pedestal and the plasma. The lower power level was set to define a power density of about 1.19 W/cm^2 relative to the exposed surface 135 of the ITO layer 130. The total flow of the reactive gas was approximately 120 sccm. In general, the uniformity is indicative of the variation in depth of the etch across the surface of the workpiece 115.

TABLE-2

HBr:HI	Uniformity	Etch Rate (angstroms per minute)	Taper Angle (Degrees)
0% HBr 100% HI	16	404	72
50% HBr 50% HI	8.7	263	50

As seen from TABLE-2, the use of a reactive gas consisting essentially of a mixture of HBr and HI improved the uniformity of the etch across the surface of the workpiece 115 compared to a reactive gas consisting

essentially of HI alone. The uniformity was determined as follows. The depth of the etch was measured at sixteen points on the workpiece 115, and the maximum, minimum and average depths were noted. The uniformity was set equal to the difference between the maximum and minimum depths, divided by twice the average depth.

Typically, the uniformity of the etch achieved using HBr alone is not as good as the uniformity achieved using HI alone under similar conditions. Thus, by using a mixture of HI and HBr, it is possible to achieve a uniformity that is better than the uniformity which results from using either HBr or HI alone.

Generally, the amount of HBr in the reactive gas 155 can be varied from slightly more than zero percent to slightly less than one-hundred percent. While a reactive gas consisting of approximately fifty percent HBr and fifty percent HI yields a substantially uniform etch of the exposed layer 135, the relative amounts of HBr and HI can be selected to control the taper angle of the etched material.

As shown in TABLE-2, a taper angle of about 72 degrees resulted from using pure HI as the reactive gas 155. When a mixture of fifty percent HI and fifty percent HBr was used, a taper angle of about 50 degrees resulted. In general, the greater the ratio of HI to HBr in the reactive gas 155, the greater the taper angle.

Additionally, in general, the greater the ratio of HI to HBr, the greater the selectivity. This makes it possible to achieve a more uniform final etch through the material layer 130 without resulting in significant etching of the substrate 120. On the other hand, the addition of HBr to the reactive gas 155 can provide a cleaner etch, resulting in less residue compared to the situation where HI alone is used as the reactive gas. Thus, using a mixture of HBr and HI as the reactive gas

155 can provide both a selective etch as well as a relatively residue-free etch.

It is believed that one or both of a chemical mechanism and an in-electric field disassociation mechanism are responsible for the observed uniform etch rates when a mixture of HBr and HI gases is used. In other words, the combination of freed radicals, H^*, Br^* and I^*, may drive reactions that volatize ITO more uniformly across the substrate surface as compared to a reactive gas that consists only of either HBr or HI. More specifically, it is believed that HBr tends to etch the surface of the ITO layer which is closer to the edges of the substrate more quickly than it etches the surface near the center, whereas HI tends to etch the surface of the ITO layer which is closer to the center of the substrate more quickly than it etches the surface near the edges. Thus, it is believed that HBr and HI compensate one another to achieve a more uniform etch.

In general, the observed uniform etch rate using a mixture of HBr and HI gases is believed to be due to both chemical and mechanical mechanisms. The applied HBr and HI gases dissociate in the presence of the RF energy field to form free radicals H^*, Br^* and I^*, where the symbol * indicates that each respective radical may be charged or uncharged. Electrically charged ones of the freed radicals (ions) are accelerated by the RF field to bombard the exposed thin-film surface 135. This bombardment is believed to result in physical breakup or micro-fragmentation of the exposed surface 135. The micro-fragments then react chemically with either the charged or uncharged radicals, H^*, Br^* and I^*.

Other implementations are contemplated within the scope of the following claims.

What is claimed is:

1. An etch method comprising:

providing a layer made of a material selected from the group consisting of an indium oxide (InO), a tin oxide (SnO), a mixture of indium and tin oxides, a compound of indium and of tin and of oxygen having the general formulation $In_xSn_yO_z$ where z is substantially greater than zero but less than 100% and where the sum x+y fills the remainder of the 100%, and a mixture of the preceding ones of said group members;

supplying a reactive gas including hydrogen bromide (HBr) and hydrogen iodide (HI) to a vicinity of the material layer; and

supplying an electric field to react the supplied reactive gas with the material layer so as to form volatile byproducts of reactive gas and the material layer.

2. The etch method of claim 1 wherein the reactive gas comprises a mixture of approximately fifty percent hydrogen bromide (HBr) and approximately fifty percent hydrogen iodide (HI).

3. The etch method of claim 1 wherein the reactive gas is supplied at a pressure at least as low as approximately 60 milliTorr.

4. The etch method of claim 1 wherein the reactive gas is supplied at a pressure at least as low as approximately 30 milliTorr.

5. The etch method of claim 1 wherein the reactive gas is supplied at a pressure of approximately 15 milliTorr.

6. The etch method of claim 1 wherein a ratio of vapor pressure to chamber pressure is at least as high as 10^5.

7. The etch method of claim 1 wherein the applied electric field is an RF field having a frequency of at least approximately 400 Kilohertz.

8. The etch method of claim 1 wherein the applied electric field has a power density of at least approximately 0.5 watt per centimeter squared (0.5 W/cm^2) as measured relative to an exposed layer portion of the material layer.

9. The etch method of claim 1 further comprising:

providing a mask layer over the material layer, the mask layer having one or more apertures defined through the mask layer for exposing corresponding one or more surface portions of the material layer to products of the reactive gas and the applied electric field.

10. The etch method of claim 1 further comprising:

providing a substrate below the material layer;

determining when the etch process etches through the material layer to the substrate; and

halting the etch process at or about the time it is determined that the etch process has etched through the material layer to the substrate.

11. The etch method of claim 1 wherein supplying a reactive gas comprises providing respective amounts of HBr and HI in the reactive gas to control the size of a taper angle formed with respect to an etched portion of the material layer.

12. The etch method of claim 11 wherein the respective amounts of HBr and HI are selected to achieve a taper angle in the range from approximately 30 degrees to approximately 72 degrees.

13. The etch method of claim 1 wherein supplying a reactive gas comprises providing respective amounts of HBr and HI in the reactive gas to control an etch rate of the material layer.

14. The etch method of claim 1 wherein supplying a reactive gas comprises providing respective amounts of HBr and HI in the reactive gas to control the selectivity of etching of the material layer compared to a substrate.

15. The etch method of claim 1 wherein supplying a reactive gas comprises providing respective amounts of HBr and HI in the reactive gas to control the uniformity of etching of a surface of the material layer.

16. The etch method of claim 15 wherein said material layer is for use in a flat panel display.

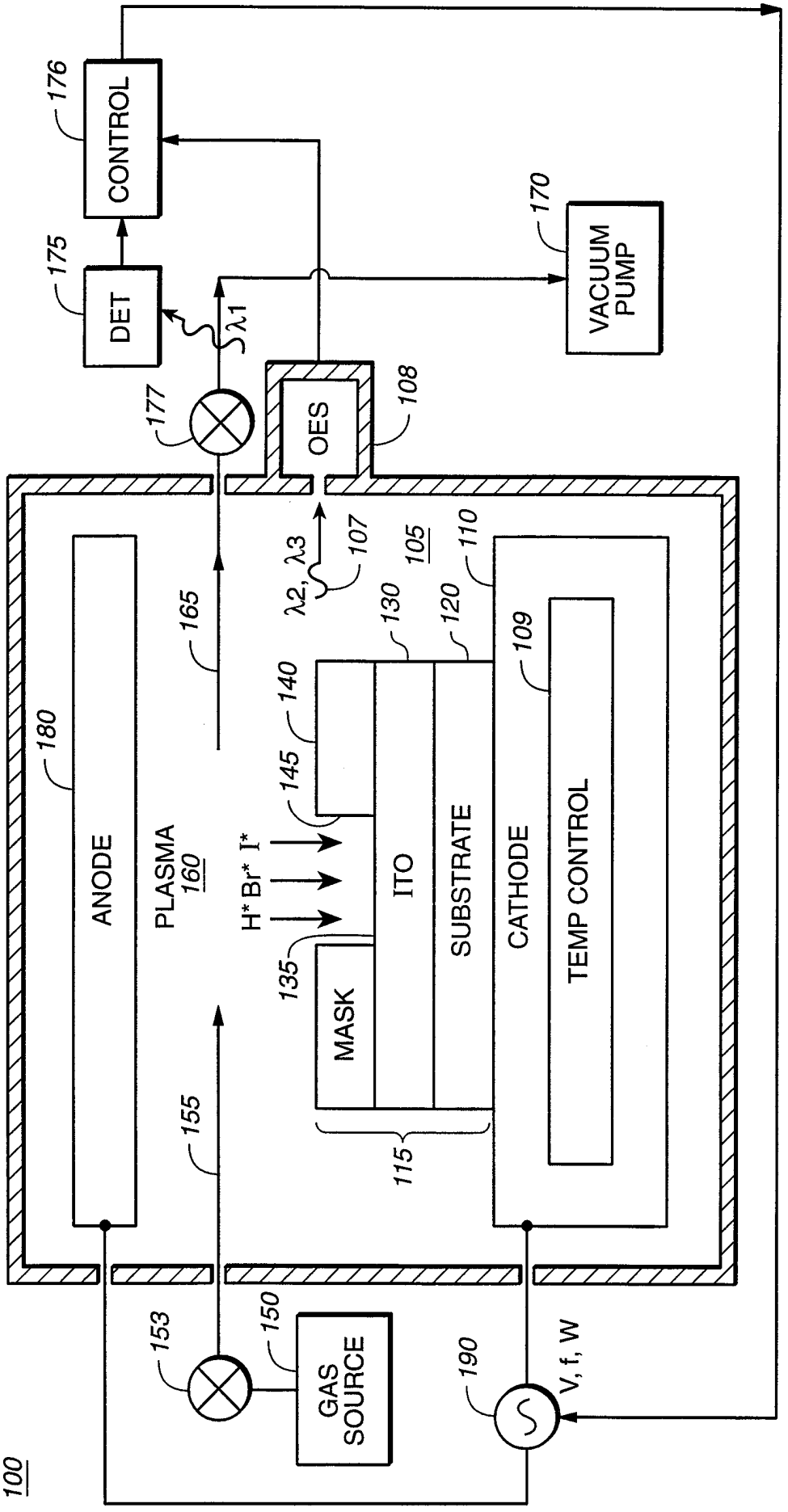

176
CONTROL
175
DET
λ1
170
VACUUM PUMP
177
OES
108
λ2, λ3
107
105
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165
130
120
109
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180
145
ANODE
PLASMA
160
H* Br* I*
ITO
SUBSTRATE
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V, f, W
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FIG._1

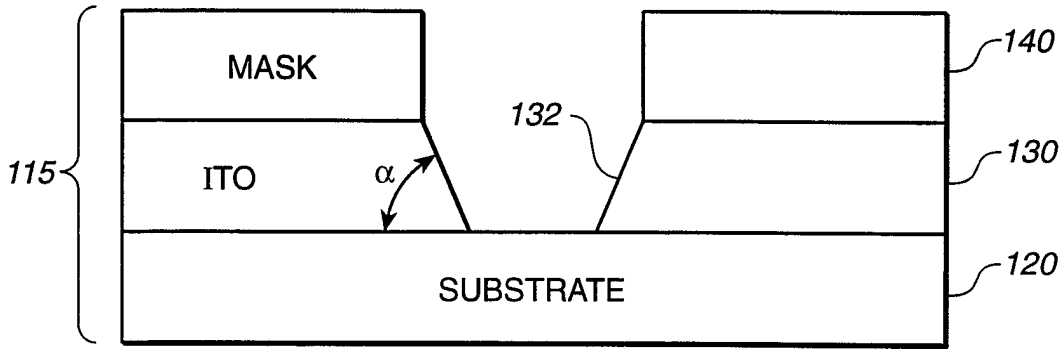


FIG._2

INTERNATIONAL SEARCH REPORT

Interna al Application No
PCT/US 98/13139

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01L31/18 H01L21/3213

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 607 602 A (GOTO HARUHIRO ET AL) 4 March 1997 see the whole document ---	1,4,5, 7-10, 13-16
A	EP 0 608 931 A (PHILIPS ELECTRONICS NV) 3 August 1994 see the whole document ---	1,7,9, 13-15
A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 461 (E-1597), 26 August 1994 & JP 06 151380 A (HITACHI LTD), 31 May 1994 see abstract --- -/--	1

[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
25 September 1998	12/10/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Visentin, A

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INTERNATIONAL SEARCH REPORT

Interna il Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 008 (E-1486), 7 January 1994 & JP 05 251400 A (NISSHIN HIGHTECH KK), 28 September 1993 see abstract	1
A	M. TAKABATAKE ET AL.: "Indium Tin Oxide dry etching using HBr gas for thin-film transistor liquid crystal displays" JOURNAL OF THE ELECTROCHEMICAL SOCIETY., vol. 142, no. 7, July 1995, pages 2470-2473, XP002078709 MANCHESTER, NEW HAMPSHIRE US	
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