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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/065,277	09/30/2002	Roman Chistyakov	ZON-001	5690

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EXAMINER	
MCDONALD, RODNEY GLENN	

ART UNIT	PAPER NUMBER
1753	

DATE MAILED: 05/27/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

INTEL 1310

Office Action Summary	Application No.	Applicant(s)	
	10/065,277	CHISTYAKOV, ROMAN	
	Examiner	Art Unit	
	Rodney G. McDonald	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 February 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-50* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-50* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 5-10, 13, 14, 16, 19, 20, 22-31, 34, 37, 38 and 40-50 are rejected under 35 U.S.C. 102(b) as being anticipated by Kouznetsov (WO 98/40532).

Kouznetsov teach in Fig. 2 a ***magnetron sputtering*** device. The sputtering device has a sputtering chamber 1 and a target 9. ***The substrate 13 is attached to some electrically isolating support 15 at the end of a wall.*** (Page 8 lines 29-37; Column 9 lines 1-6) ***A magnet or magnets 17*** are mounted so that the north pole or poles are arranged at the periphery of the target and the south pole or poles at the center of the target 9. ***One electrode, the anode, is formed by the electrically conducting walls 5 of the housing 3, which e.g. can be grounded.*** The other electrode, ***the cathode, is formed by the target 9***, which is thus negatively biased in relation to the anode. The substrate 13 can have some neutral electric potential. A gas inlet for a suitable gas to be ionized such as argon is indicated at 21. (Page 9 lines 7-20) It should be noted that the anode and cathode always have a gap in order to create the plasma. (Applies to Applicant's claim 41)

When increasing the voltage form zero and on between the anode 5 and the cathode 9, there will for some applied voltage appear an electric glow discharge. ***The***

gas in the region between the anode and the cathode will be partly ionized by electrons. The ***electrons*** will be somewhat trapped or confined by the magnetic field primarily moving in the areas of low magnetic field intensity. (Page 9 lines 21-25) Inherently ground state atoms exist because the gas is not ionized initially. Electrons are needed to ionize in the partially ionized state and the fully ionized state discussed below. (Applies to Applicant's claims 42, 43, 46 and 48)

An electric discharge occurs between the cathode and the anode producing electrons trapped in the magnetic field by cooperation of the electric field produced by the applied voltage. (Page 4 lines 27-31)

When increasing the voltage and current more, there will appear the state comprising ***completely ionized plasma region 27***, the region being stationary located above the surface of the target 9 and having a larger extension laterally, in the direction of the surface of the target 9 than the regions 23 of high electron and ion density used in ordinary sputtering. ***This state is made possible by the arrangement of the electric and magnetic fields crossing each other in the magnetron*** configuration. Furthermore, in this state, owing to the considerable extension and the relative homogeneity and uniformity of the ionized plasma in the region 27, ***ions will hit the target surface more regularly and uniformly distributed over the surface. This will result in a more homogeneous wear of the target surface,*** as illustrated by the area delimited by the dashed line 29 in Fig. 5b. (Page 10 lines 13-23)

The power source is a pulse generator used primarily to produce coatings by sputtering. The power of each pulse can be in the range of 0.1 KW to 1 MW. ***The***

pulses can have a duration in the range of less than a hundred microseconds up to hundreds of microseconds and the intervals between pulses can range from milliseconds up to seconds. (Page 4 lines 14-23)

The voltage can be hundreds of volts up to several kilovolts. (Page 6 lines 24-25) The rise time is calculated form the time and voltage discussed above. (Applies to Applicant's claims 44, 45, 49 and 50)

The electric circuit will be generate at the frequency of the main supply typically with ***a frequency of 50 or 60 Hz.*** (Page 12 lines 14-15)

Alternating current is supplied from the power supply. (Page 6 lines 15-16)

Claims 1, 4, 5, 7, 13, 14, 16, 19-25, 27-29, 32, 33, 37 and 40 are rejected under 35 U.S.C. 102(b) as being anticipated by Mozgrin et al. "High Current Low-Pressure Quasi-Stationary Discharge in a Magnetic Field: Experimental Research", Plasma Physics Reports, Vol. 21, No. 5, 1995, pp. 400-409.

Mozgrin et al. teach a sputtering system as seen in Figure 1 having ***a cathode*** (1), ***an anode*** (2) and ***a magnetic system*** (3). (See Figure 1 pp. 401)

Figure 2 presents a simplified scheme of the ***discharge supply system.*** The supply unit involved ***a pulsed discharge supply unit*** and ***a system for pre-ionization***. The ***quasi-stationary*** discharge supply unit consisted of a long line of W= 5.5 kJ maximal energy content, a switch and a matching unit. The pre-ionization system provided direct current. (Page 401)

A gas of argon is pre-ionized at a pre-ionized plasma density of

10^7-10^9 cm^{-3}. The pre-ionization could be provided by RF discharge, anomalous glow or magnetron discharge. (Page 401)

A pulsed discharge is utilized to deposit copper material in argon plasma with a plasma density of $3*10^{12}$ cm^{-3}. The pulse duration was 25 ms with a repetition frequency of 10 Hz. (Page 403-404)

The current density for argon discharges can be 25 A/cm^2. (Page 403)

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kouznetsov (WO 98/40532).

Kouznetsov is discussed above and all is as applies above.

The differences between Kouznetsov and the present claims are that the constant power is not discussed and the constant voltage is not discussed.

As to the constant power and the constant voltage Kouznetsov power supply provides this feature when operating in the crossed E and B field region since the power and voltage must be constant during this time period to produce a state of full ionization. (See Figure 1)

The motivation for operating at constant power and constant voltage is that it allows production of full ionization during sputtering operation. (See Abstract; Figure 1)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have utilized constant power and voltage as taught by Kouznetsov because it allows for producing a state of full ionization.

Claims 1-3, 17, 20 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mozgrin et al. "High Current Low-Pressure Quasi-Stationary Discharge in a Magnetic Field: Experimental Research", Plasma Physics Reports, Vol. 21, No. 5, 1995, pp. 400-409.

Mozgrin et al. is discussed above and all is as applies above.

The differences between Mozgrin et al. and the present claims is that the constant power is not discussed, the constant voltage is not discussed and the ionization source being a UV source, an X-ray source, an electron beam source and an ion beam source is not discussed.

As to the constant power and the constant voltage Mozgrin et al. teach pulsing in square wave form which produces a constant power and constant voltage at the height

of the square wave form in order to produce a plasma density higher than the pre-ionization plasma density. (See page 401, 404)

As to the ionization source for generating the weakly-ionized plasma the RF discharge, anomalous glow or magnetron discharge, etc. is believed to be a source of ions and can be interpreted as a beam of ions. (See page 401)

The motivation for utilizing a constant power and constant voltage is that it allows for production of a higher density of plasma than during the pre-ionization. (See page 401, 404)

The motivation for utilizing a separate ionization source is that it allows for the necessary pre-ionization before producing the higher density plasma. (See page 401)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Mozgrin et al. by utilizing a constant power, constant voltage and an ionization source because it allows for production of a low density plasma before the production of a higher density plasma.

Claims 1, 10-12, 15, 20 and 34-36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kouznetsov (WO 98/40532) in view of Chiang et al. (U.S. Pat. 6,398,929).

Kouznetsov is discussed above and all is as applies above. (See Kouznetsov discussed above)

The differences between Kouznetsov and the present claims is that the temperature control of the substrate is not discussed, biasing the substrate is not discussed and applying DC power to the target is not discussed.

Chiang et al. teach a cool plasma ignition and processing sequence is illustrated in the flow diagram of FIG. 12. After the wafer has been inserted through the load lock valve into the sputter reactor, the load lock valve is closed, and in step 190 gas pressures are equilibrated. The argon chamber pressure is raised to that used for ignition, typically between 2 and about 5 to 10 milliTorr, and ***the argon backside cooling gas is supplied to the back of the wafer at a backside pressure of about 5 to 10 Torr.*** In step 192, the ***argon is ignited with a low level of target power***, typically in the range of 1 to 5 kW. After the plasma has been detected to ignite, in step 194, the chamber pressure is quickly ramped down, for example over 3s, with the target power held at the low level. If sustained self-sputtering is planned, the chamber argon supply is turned off, but the plasma continues in the SSS mode. ***For self-ionized plasma sputtering, the argon supply is reduced.*** The backside cooling gas continues to be supplied. Once the argon pressure has been reduced, in step 196, ***the target power is quickly ramped up to the intended sputtering level, for example, 10 to 24 kW or greater*** for a 200 mm wafer, chosen for the SIP or SSS sputtering. It is possible to combine the steps 194, 196 by concurrently reducing pressure and ramping up the power. In step 198, the target continues to be powered at the chosen level for a length of time necessary to sputter deposit the chosen thickness of material. This ignition sequence is cooler than using the intended sputtering power level for ignition. The higher argon pressure facilitates ignition but would deleteriously affect the sputtered neutrals if continued at the higher power levels desired for sputter deposition. At the lower ignition power, very little copper is deposited due to the low deposition rate at the

reduced power. Also, ***the pedestal cooling keep the wafer chilled through the ignition process.*** (Column 16 lines 9-42)

The entire system can be controlled by a computer based controller. (Column 17 lines 39-45)

Some designs utilize a controllable power supply 112 to apply ***a DC or RF bias to the wafer holder.*** (Column 1 lines 45-46)

A DC power supply biases the target during sputtering. (Column 11 lines 37-40)

The motivation for controlling the temperature is that it allows for keeping the substrate cool during ignition. (Column 16 lines 41-42)

The motivation for applying a bias to the substrate holder is that it allows control of the DC bias that develops on the substrate. (Column 11 lines 45-48)

The motivation for utilizing a DC power source on the target is that it allows for ignition and maintenance of the plasma. (Column 11 lines 37-40)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Kouznetsov by utilizing a temperature control, a bias to the substrate and dc power to the target as taught by Chiang et al. because it allows for keeping the substrate cool during ignition, controlling the DC bias that develops on the substrate and igniting and maintaining the plasma.

Claims 1 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kouznetsov (WO 98/40532) in view of Kadlec et al. (WO 95/04368).

Kouznetsov is discussed above and all is as applies above. (See Kouznetsov discussed above)

The difference between Kouznetsov and the present claims is that the use of an electromagnet is not discussed.

Kadlec et al. teach igniting a discharge at a first power and then increasing the power. (Page 8 lines 16-35; Page 9 lines 1-14)

Kadlec further suggests the use of electromagnets for sputtering. (Page 14 lines13-31)

The motivation for utilizing an electromagnet is that it allows control of the magnetic field such as controlling the magnetic field to disbalanced. (Page 14 lines 13-31)

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified Kouznetsov by utilizing an electromagnet as taught by Kadlec et al. because it allows for controlling the magnetic field.

Response to Arguments

Applicant's arguments filed 2-24-05 have been fully considered but they are not persuasive.

The obviousness-type double patenting rejection has been overcome.

In response to the argument that neither Kouznetsov or Mozgrin teach a multi-step ionization process whereby atoms are excited from a ground state to a weakly ionized plasma then to a highly ionized plasma, it is argued that Kouznetsov's initial admission of gas would have ground state atoms although not specifically mentioned.

The initial gas is not ionized until a time later where it passes through a weakly ionized state to a highly ionized state. During the weakly ionized state some atoms of the gas would be ionized but some would not. Those that do not would still be some ground state atoms. Progressing to the highly ionized state substantially all the atoms would be ionized. Electrons cause the ionization. In Mozgrin the initial gas would have atoms at ground state. The atoms are pre-ionized. The pre-ionized state would have some atoms in the round state. The fully ionized state would be during the pulse discharge. (See Kouznetsov and Mozgrin discussed above)

In response to the argument that Kouznetsov is utilizing direct ionization and not Applicant's multi-step ionization process, it is argued that the voltage is increased in the pulse the gas will undergo various ionizations and excited states until being fully ionized as suggested by Kouznetsov. (See Kouznetsov discussed above)

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rodney G. McDonald whose telephone number is 571-272-1340. The examiner can normally be reached on M- Th with Every other Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam X. Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Rodney G. McDonald
Primary Examiner
Art Unit 1753

RM
May 25, 2005