FRANK B. DEHN & Co.

Patent and Trade Mark Attorneys

St Bride's House, 10 Salisbury Square, London EC4Y 8JD
Telephone: +44 (0)20 7632 7200 Fax: +44 (0)20 7353 8895
E-mail: mail@frankbdehn.com Web: www.frankbdehn.com

European Patent Office
D-80298 München
Germany

date 24 July 2007
your ref
our ref 31.32.89113

EPO - Munich
63
25. Juli 2007

Dear Sirs

European Patent Application No. 04716928.9 (1614136)
Regional Phase of PCT Application PCT/US2004/006456
Zond, Inc.

In reply to the Official Communication dated 15 December 2006, we enclose replacement pages 1, 2, 2a, 3, 4, 9, 23, 26-28, 30-32 and 34-37 to replace the pages 1-4, 9, 23, 26-28, 30-32 and 34-37 currently on file.

The Examiner objected that the independent claims 1 and 15 lacked novelty over documents D1 and D2. Amended apparatus claim 1 now includes the feature of claim 2, namely that the excited atom source comprises a magnet for trapping electrons proximate to the ground state atoms. Method claim 15 (now claim 14) has been similarly amended.

In the examination report, with regard to claim 2, the Examiner referred back to the IPRP. In that report, the Examiner gave the opinion that claim 2 also lacked novelty over D1 and D2, but gave no detailed reasoning. We respectfully disagree with his objection.

D1 discloses a first plasma generating means which excites atoms to a metastable state and a second plasma generating means for activating the gas. However, D1 does not disclose the use of a magnet anywhere within the apparatus. In particular, D1 does not disclose the use of a magnet within the first plasma generating means for trapping electrons proximate to the ground state atoms as require by amended claim 1.

D2 relates to a continuous plasma laser. In D2, the multiple anodes and cathodes along the length of the chamber excite the atoms into a metastable state to await stimulated emission back to the ground state. The whole apparatus of D2 therefore may be considered an excited atom source. However, D2 does not disclose a further anode and cathode separate from the excited atom source which are used together with a power supply to ionize the excited atoms.

We therefore submit that independent claims 1 and 14 (previously 15) are novel over both documents D1 and D2.

The closest prior art for the purpose of assessing inventive step is D1 as it is in the same technical field as the present invention and addresses the same problem of improving plasma activation efficiency.

The difference between claim 1 and the apparatus of D1 is the provision of a magnet in the excited atom source for trapping electrons proximate to the ground state atoms. Starting from D1, the technical problem facing a skilled person is the further improvement in activation efficiency and the solution provided by claim 1 is the generation of a magnetic field for trapping electrons in the excited atom source. D1 provides no hint or suggestion that magnets should be used anywhere in the apparatus, let alone specifically in the 1st plasma generation means. We therefore submit that claim 1 is inventive over D1.

As mentioned above, D2 relates to a different technical field, i.e. the field of lasers. Although the apparatus of D2 may (as mentioned above) be considered to be an excited atom source, we submit that a skilled person faced with the above problem would not consider looking to the field of lasers when trying to solve it. In lasers, atoms are raised to the metastable state so that they can be stimulated back to the ground state. In contrast, in the two-step plasma generation process of the present invention, atoms are raised to the metastable state as a preliminary stage before ionization. The apparatuses are therefore fundamentally different.

Further even if the skilled person were to look to the teachings of D2, we submit that he would still not arrive at the teachings of the present invention. Although D2 teaches the application of a magnetic field within the chamber (via solenoid 151, column 11, lines 36-36), the field is not for the purpose of trapping electrons. Rather the field is used to forcibly move atoms away from their origin by driving them to another anode further down the chamber (column 11, lines 53-58). D2 therefore teaches away from the present invention.

We therefore submit that claim 1 is also inventive over a combination of documents D1 and D2.

The above arguments have been given in respect of apparatus claim 1, but they apply equally to method claim 14.

As requested by the examiner, we have also acknowledged both documents D1 and D2 in the description and we have inserted a statement of invention corresponding to amended claim 1. Reference numbers have been added to the claims and the independent claims have been characterised over document D1. SI units have been inserted into the description next to their non-SI counterparts. We have also corrected the errors noted by the Examiner in paragraphs [0119] and [0142] and we have removed the phrase "spirit and" from the last paragraph of the description.

24 July 2007
31.32.89113

We trust that this application is now in order for grant. However, in the event that the examining division intend to reject the application at any stage, we hereby request Oral Proceedings.

Form 1037 is enclosed for acknowledgement purposes.

Yours faithfully
Frank B. Dehn & Co.

Robert Jackson

Encs

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Patent and Trade Mark Attorneys

St Bride's House, 10 Salisbury Square, London EC4Y 8JD
Telephone: +44 (0)20 7632 7200 Fax: +44 (0)20 7353 8895
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Dear Sirs

European Patent Application No. 04716928.9 (1614136)
Regional Phase of PCT Application PCT/US2004/006456
Zond, Inc.

I hereby request further processing of this application in accordance with Article 121 EPC.

I enclose a Fee Voucher authorising the withdrawal of the further processing fee from our Deposit Account No. 28050069 in respect of the fee for further processing.

A response to the Official Communication of 15 December 2006 is filed herewith.

A Form 1037 is enclosed for acknowledgement purposes.

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Yours faithfully
Frank B. Dehn & Co.

Robert Jackson

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SPECIFICATION

Plasma Generation Using Multi-Step Ionization

~~Background of Invention~~

[0001] Plasma is considered the fourth state of matter. A plasma is a collection of charged particles that move in random directions. A plasma is, on average, electrically neutral. One method of generating a plasma is to drive a current through a low-pressure gas between two conducting electrodes that are positioned parallel to each other. Once certain parameters are met, the gas "breaks down" to form the plasma. For example, a plasma can be generated by applying a potential of several kilovolts between two parallel conducting electrodes in an inert gas atmosphere (e.g., argon) at a pressure that is between about 10^{-1} and 10^{-2} Torr. (between about 10 and 1 Pa)

[0002] Plasma processes are widely used in many industries, such as the semiconductor manufacturing industry. For example, plasma etching is commonly used to etch substrate material and films deposited on substrates in the electronics industry. There are four basic types of plasma etching processes that are used to remove material from surfaces: sputter etching, pure chemical etching, ion energy driven etching, and ion inhibitor etching.

[0003] Plasma sputtering is a technique that is widely used for depositing films on substrates and other work pieces. Sputtering is the physical ejection of atoms from a target surface and is sometimes referred to as physical vapor deposition (PVD). Ions, such as argon ions, are generated and are then drawn out of the plasma and accelerated across a cathode dark space. The target surface has a lower potential than the region in which the plasma is formed. Therefore, the target surface attracts positive ions.

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