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Reg. No. 42,557

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LAM RESEARCH CORP.,

Petitioner

v.

DANIEL L. FLAMM,

Patent Owner

CASE IPR2015-01767
U.S. Patent No. 6,017,221

DECLARATION OF DANIEL L. FLAMM, Sc.D.

I, Daniel L. Flamm, Sc.D., hereby declare as follows:

1. I am a U.S. patent attorney, and member of the California State Bar. Prior to this, I worked in academia, research, and industry in various roles for more than 50 years. My curriculum vitae, which includes a more detailed summary of my background, experience, and publications, is attached as Appendix A.
2. I have been a leading researcher and educator in the fields of semiconductor processing technology, air pollution control, materials science, and

other areas of chemical engineering. My research has been funded by NASA, National Science Foundation, Environmental Protection Agency, and AT&T Bell Laboratories. While a Distinguished Member of Technical Staff at Bell Laboratories, I led a semiconductor processing research group comprised of research colleagues, visiting university scientists, postdoctoral associates, and summer students. I have also served as a technical consultant to various semiconductor device and processing equipment manufacturers.

3. I have published over 150 technical journal articles and books, and dozens of articles in conference proceedings, most of them in highly competitive refereed conferences and rigorously reviewed journals. I am an inventor in more than 20 U.S. patents, a number of which have been licensed, and most being in the general field of semiconductor processing technology.

4. I had experience studying and analyzing patents and patent claims from the perspective of a person having ordinary skilled in the art (“PHOSITA”) starting at least at the time of my employment at AT&T Bell Laboratories in 1977. At AT&T Bell Laboratories, I served as a member of the patent licensing review committee where I was responsible for reviewing hundreds of patents for potential utility and licensing potential. I have also served as a technical expert in patent disputes and litigation.

5. I was admitted to the patent bar as an Agent in 2003 and have been

registered as a Patent Attorney since 2006.

6. I am inventor of U.S. Patent No. 6,017,221, in the name of Daniel L. Flamm and titled “Process Depending on Plasma Discharges Sustained by Inductive Coupling” (“the ‘221 Patent”).

7. I have read Lam’s Petition for *Inter Partes* Review in this matter and the various art cited therein, including Lieberman 93 (Ex. 1002) and Dible (Ex. 1003). I have also reviewed the ‘221 patent and the art cited below.

8. Lieberman provides no means to adjust or control anything. The isolated secondary winding in the conventional magnetic flux coupled balanced transformer suggested by Lieberman cannot control the coil potential because it is floating. Its voltage and voltage distribution when it is coupled to a processing chamber is determined by the detailed coupling of elements of the coil to process-specific plasma conditions and compositions.

9. Lieberman teaches a conventional balanced magnetic transformer, which is not a balun.

10. A magnetic transformer is not a balun transformer; it is an essentially different thing. A conventional magnetically coupled transformer, such as depicted by Lieberman, transmits input energy to the output circuit through magnetic flux linkage, and the conventional transformer is capable of DC isolation. A conventional transformer suffers from large core and winding losses as frequency

increases and inherently suffers from even higher disproportionate losses in higher power applications, such as here, powering a processing chamber plasma.

11. A balun transformer is a transmission line transformer that depends on coupling input energy to a load using a transverse transmission line mode, wherein an electromagnetic field is completely contained within the transmission line. In a balun transmission line transformer, unlike conventional transformers, the magnetic flux is effectively canceled out in the core, whereby far higher efficiencies can be obtained over a far wider range of frequencies. A balun transformer, unlike the conventional magnetic transformer, is not capable of DC isolation because a balun requires a conductive connection to ground to be functional.

12. A PHOSITA having expertise in high frequency matching systems would have recognized that in practice Lieberman's coil midpoint, the so-called virtual ground, would not maintain ground potential when powering a plasma during processing. Because the transformer secondary is "floating," all positions along the coil have no determinable voltage relative to ground before a load coupled to ground is provided. Having the midpoint coil voltage be midway from the upper and lower end voltages of the coil requires that the upper (above the midpoint) and lower segments of the coil be coupled to identical loads (the capacitive and inductive coupling between the plasma and coil must be axially and radially symmetric about a midpoint). This, in turn, requires plasma sheath

thickness and plasma density (and potential) at all positions above the midpoint to be a mirror image of the values below the midpoint, which is unlikely or impossible to occur where the plasma source is coupled to a processing chamber.

13. Plasma processing requires that plasma stream from the source toward the workpiece in the chamber. Since the streaming creates a plasma density gradient along the vertical axis in cylindrical geometry there is no midpoint load symmetry.

14. If the transformer secondary is “floating,” as Lieberman has stipulated, the values of all of the voltages along the coil, and in particular those of the upper end of the coil, the lower end of the coil, and the midpoint, will depend on the detailed “load” (*e.g.*, the plasma density, its spatial distribution, the plasma potential, and position of the inductive plasma current ring). This is because the voltage drop (voltage difference) between the midpoint and one end of any physical coil, and particularly one carrying high frequency current, varies with the local value of load coupled to that portion of the physical coil.

15. The proposition that voltage would be reduced by a factor of two is flawed. That is at least because the geometric extent and position of the induced plasma current ring (inductively coupled plasma absorbing power) depends on the detailed distribution of current along the applicator coil. Since Lieberman never clearly defines a reference configuration such as the electrical length (wavelength

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