

Characteristics of Core ICP Source For Solar Cell Deposition Equipment



Joung-Ho, Lee & Dae-Kyu, Choi

Solar Cell Industry Requirement

Lower production cost

Large area substrates

Higher Deposition

Rates

▶ Increasing the frequency

Excellent Uniformity

▶ Optimize electrode shape

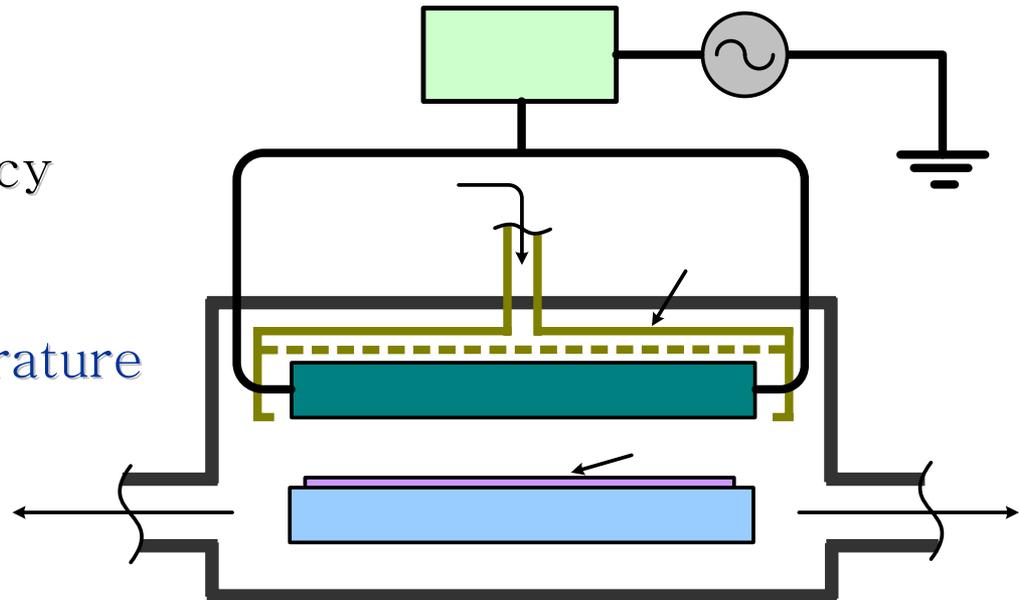
[Ref.] Y.Takeuchi, Thin Solid Films 390(2001) 217-221
Youji Nakano, Thin Solid Films 506-507 (2006) 33-37

PECVD Equipment



❖ VHF PECVD

- 30~300MHz Frequency
- High Density Plasma
- Low Electron Temperature



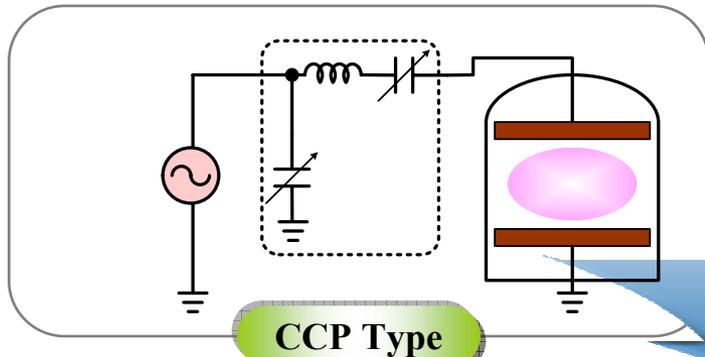
➔ Electrical Problems

- ✓ The Reactor needs to be treated as a transmission line.
- ✓ Very Hard to obtain matching between a reactor and a power source.

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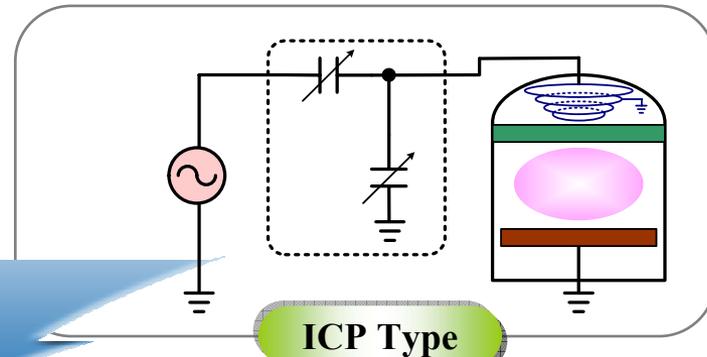
Plasma Generating Method

Capacitively Coupled Plasma



Good Repeatability

Inductively Coupled Plasma



High Density

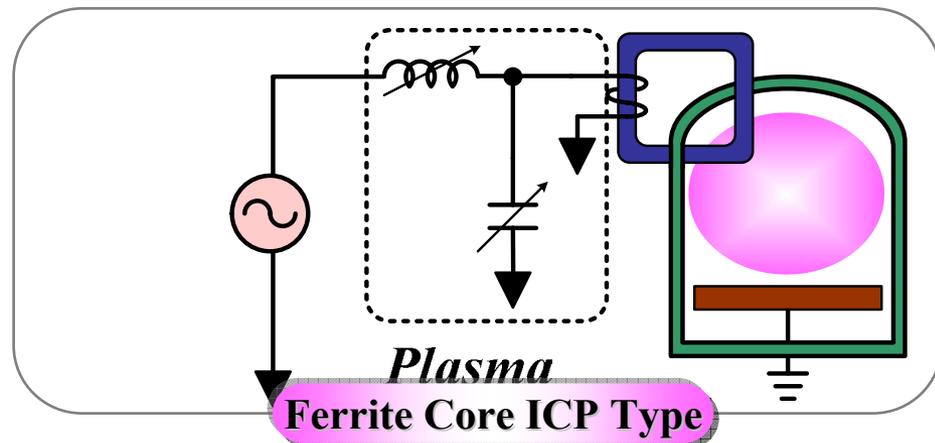
New Plasma Generation Method

1. Independently Plasma Generation by Isolated energy transfer structure

▶ Decrease in aspect of Damage,
Good Plasma Repeatability

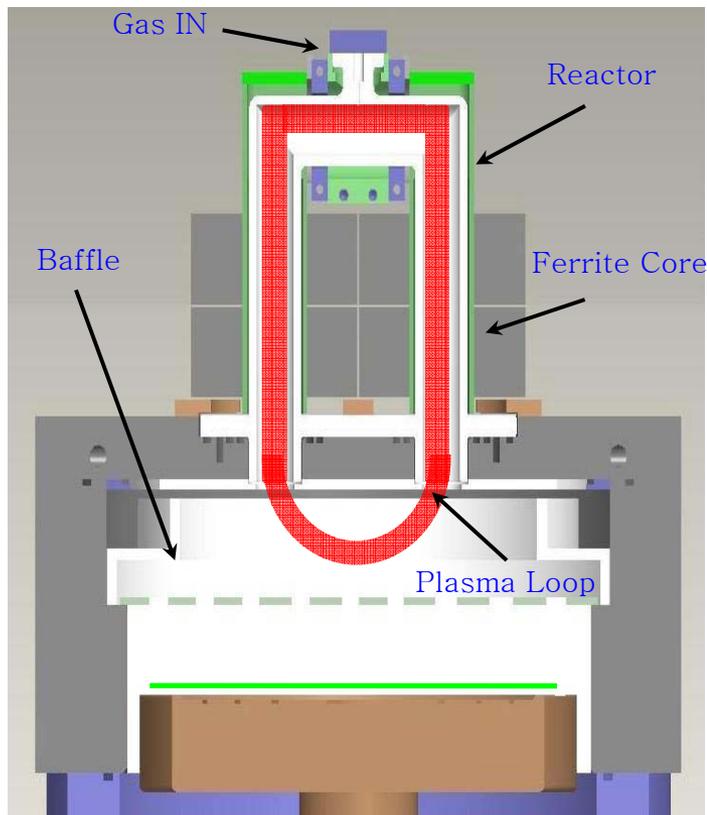
2. High Efficiency RF Generator & Plasma Source

▶ High Density Plasma due to Plasma Control



Core ICP Source

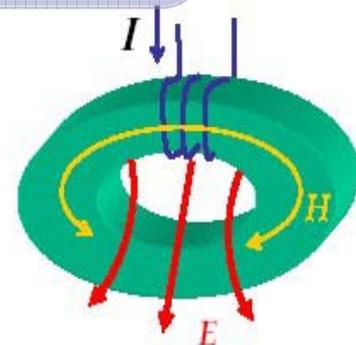
❖ Ferrite Core Inductively Coupled Plasma Source



● Section View

Plasma Source Principle

$$\mathbf{H}_{\text{air}} = \left(\frac{\mu_{\text{core}}}{\mu_{\text{air}}} \right) \mathbf{H}_{\text{core}}, \frac{\mu_{\text{core}}}{\mu_{\text{air}}} \gg 1$$
$$\mathbf{E} \propto \omega \mathbf{H}_{\text{air}} \leftarrow \nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} = \frac{\partial (\mu \mathbf{H})}{\partial t}$$

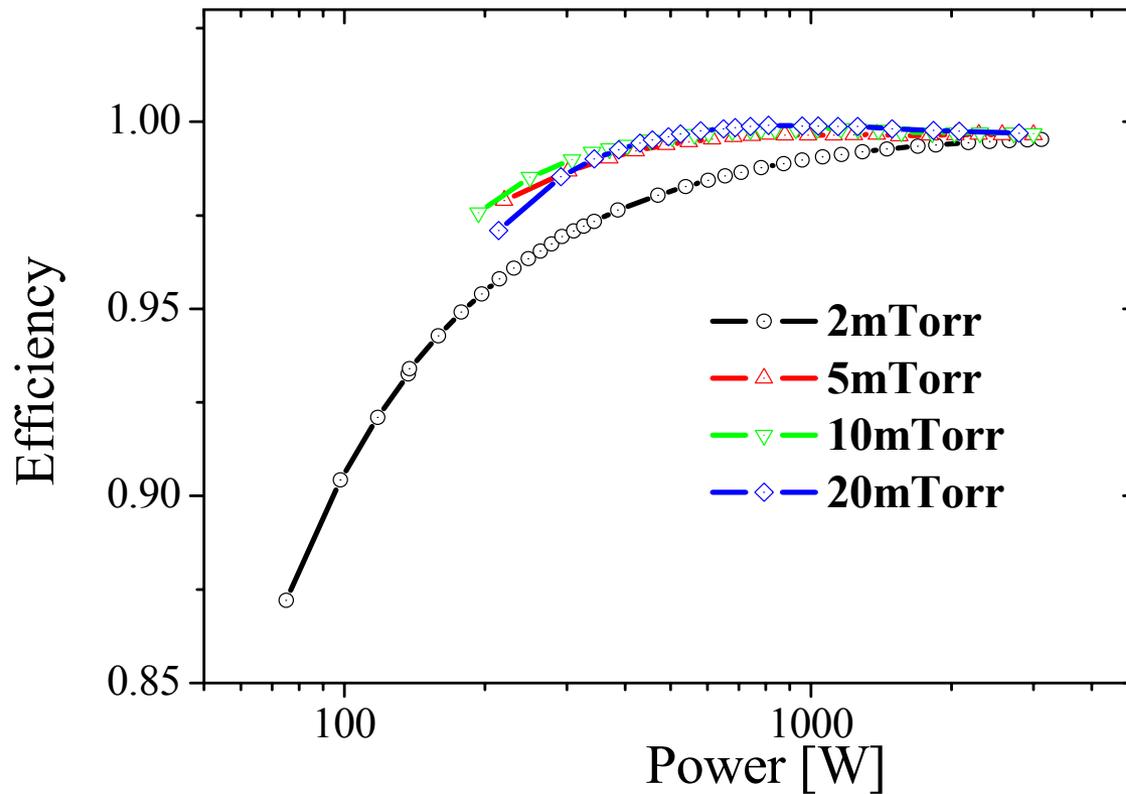


1. Linearity of Density to Power
(High Density Plasma)
2. Low Plasma Potential
(Low Electron Temperature)
3. Lower Antenna Voltage

Plasma Characteristics

● Antenna Efficiency as Power increases

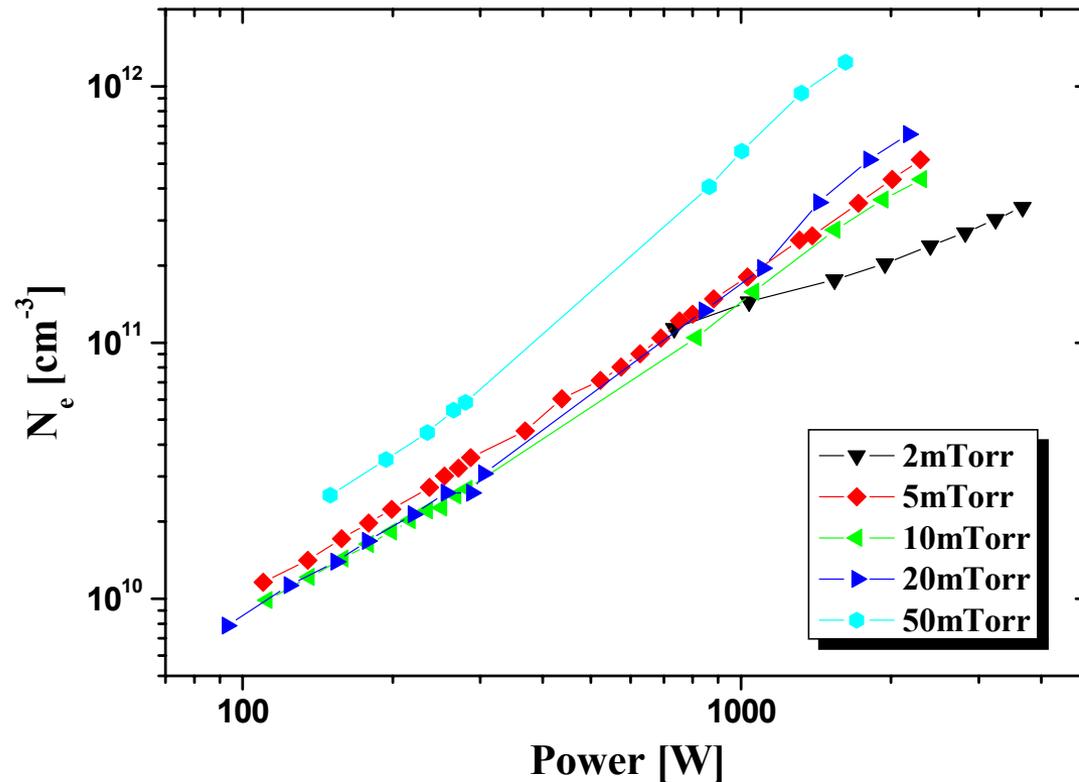
: Antenna Current ↓ & Antenna Power Loss ↓



Plasma Characteristics

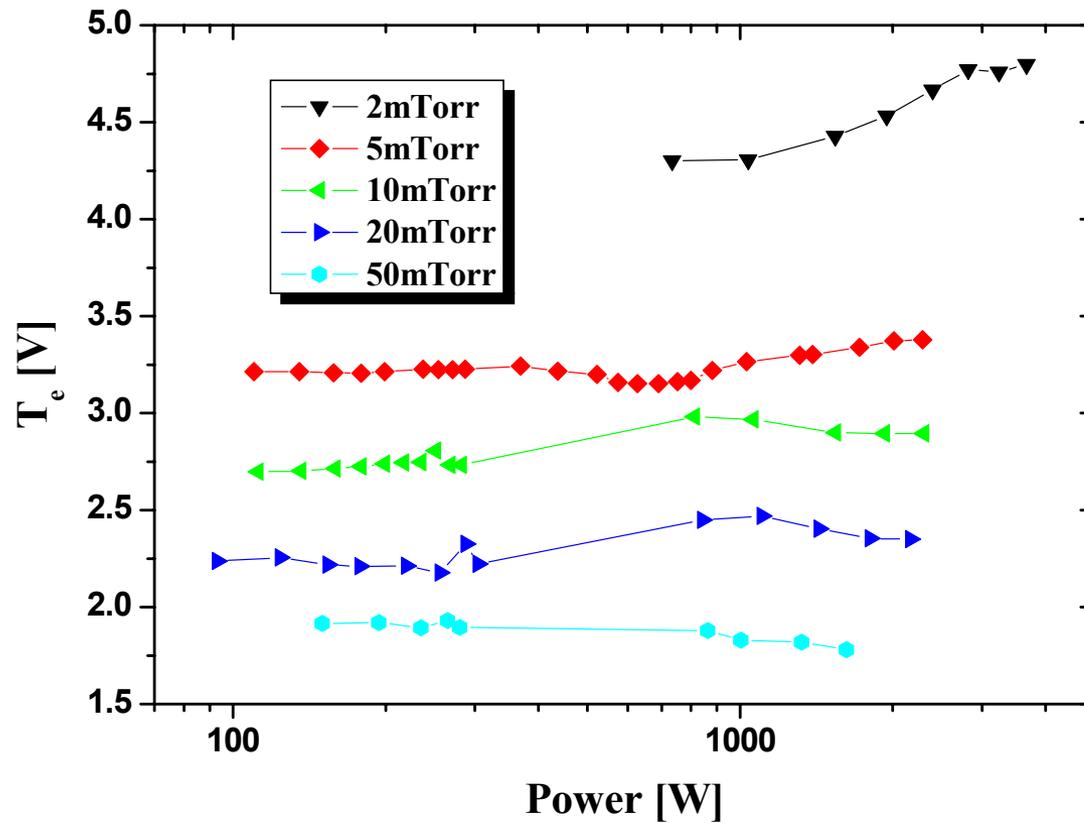
● Electron Density as Power increases

: 2~ 3 times more than that of conventional ICP plasma source



Plasma Characteristics

- Electron temperature as Power increases
 - : Lower Electron Temperature



Introduction of Company

Company Name

New Power Plasma

President

Dae Kyu, Choi

Established

Dec, 1993

Employees

Total 130 People

Address

Suwon, Korea

Patents

Total 230 (Korea 180 , Overseas 50)

Website

<http://www.newpower.co.kr>

RF Source + Plasma Source = Plasma Equipment

RF GNENERATOR



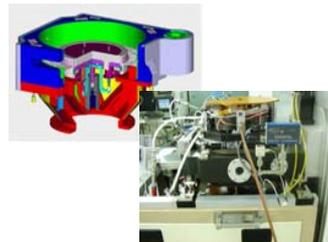
MATCH



RPG



Plasma Source



Plasma Equipment



NEW POWER PLASMA CO., LTD.

Technology progression of NPP



1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

● Matcher(13.56MHZ / 2kW) etc

● RF Generator(13.56MHZ / 1.25kW) etc



1'st G

● Develop High Power RF Item (13.56MHZ / 30KW, 50KW)

● RPG, RF Generator(400kHz)

● Dry Scrubber

● Atmosphere Plasma

● Developed Core-ICP™



● Develop Advance RF Plasma Source

● Develop Super-RS™

2'nd G

● 200mm Asher Rebuild

● Developed Gen-Core™ ASH-2000,3000

3'rd G



● Development Other Plasma Application Equipment

● CVD & Etch

4'th G

Semiconductor'
Main Parts

Plasma Application

Plasma Equipment



RF Department



Equipment
Department



Thank you for attention!!!

<http://www.newpower.co.kr>