

Critical review of plasma technologies for industrial applications

Kuniko Urashima

Science and Technology Foresight Center, National Institute of Science and Technology Policy,
MEXT, Tokyo

e-mail: urashima@nistep.go.jp

1. Preface

Plasma technology has already been put to practical use and applied to many products. Plasma processes are carried out in either the high-temperature environment of transferred and non-transferred plasmas or at pressures low enough to give large active volumes with higher electron and lower gas temperature glow discharge plasmas.

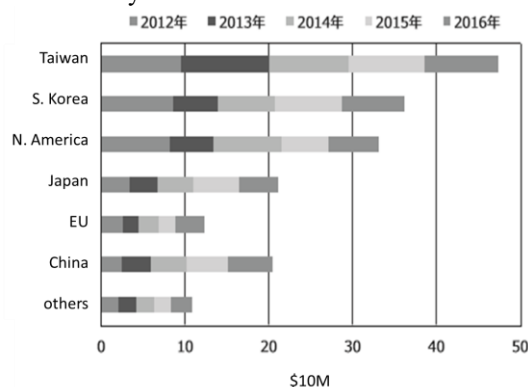
In addition to conventional semiconductor manufacturing, exhaust gas treatment, waste disposal, air cleaning, purification of contaminated water, it has recently been applied to medical fields such as treatment of cancer and skin diseases.

This paper is a short review of current situation of plasma technologies application and its trends from around the world.

2. Application of Plasma technologies

2-1 Semiconductor business

As Figure 1 shows that the market of semiconductor manufacturing equipment has been expanding in the world. Especially many Asian countries such as Taiwan and South Korea have been keeping large share of market constantly.



Source: SEAJⁱ

Fig. 1 Market and forecast (2016) of semiconductor manufacturing equipment

2-2 Gaseous pollution control

Air quality significantly influence to our health so that pollution control technology research is getting more important. Gaseous pollution control technologies that using plasma technologies for NO_x, SO_x etc., VOC, greenhouse gases, ozone layer depleting substance etc., have been commercialized. There are several conventional methods of pollution control such as chemical filtration, plasma methane or natural gas reforming, coal gasification, higher hydrocarbons reforming and water electrolysis. Because of by-products

concerning during treatment processes, non-thermal plasma techniques and catalyst has been combined used together.

Recently, problems of indoor air quality are recognized as important risk factors for human health in both low- and middle- and high-income countries. Indoor air is also important because people spend a substantial proportion of their time in buildingsⁱⁱ. In residences, day-care centres, retirement homes and other special place, indoor air pollution affects population groups that are particularly vulnerable owing to their health status or age. This matter is more significant problem for aging society as well.

2-3 Agriculture

Plasma irradiation can be used to promote germination, promotion of seedling growth, electrostatic spraying, weeding, electro pollination, etc. too. In recent years, it has spread to agriculture fields by taking advantage of its characteristics. For example, increased production of fungi, sterilization of hydroponics, freshness of vegetables and fruits, and dust removal inside agricultural facilities has been researchingⁱⁱⁱ.

2-4 Waste water treatment

Several eligible non-thermal plasma technologies are already finished for small scale pilot test, and its already in the stage of commercialization for treatment of waste water^{iv}.

2-5 Medical application

The new field of plasma medical science has been observed and introduced plasma science into medicine is pressing recently^{v vi}.

References

- ⁱ Seaj Home Page,
http://www.seaj.or.jp/english/statistics/page_en.php?CMD=1
- ⁱⁱ A.Luengas et.al., A review of indoor air treatment technologies, Reviews in Env. Sci. and Bio/Tech., 2015, Vol.14, 3, 499–522|
- ⁱⁱⁱ Takaki et. al., J, Plasma Fusion Res. Vol. 90, No. 9 (2014) 534-540
- ^{iv} M. Dors, PlasTEP,
http://www.plastep.eu/fileadmin/dateien/Events/2011/110725_Summer_School/Plasma_water_treatment.pdf
- ^v J. Schlegela, et. Al., Clinical Plasma Medicine, Vol.1, 2, (2013), 2-7
- ^{vi} Plasma medical global center, E.g.
http://plasmamed.nagoya-u.ac.jp/center_en/publications/