MICROWAVE DISCHARGES AT REDUCED PRESSURES AND PECULIARITIES OF THE PROCESSES IN STRONGLY nonuniform plasma

Yu.A. Lebedev

Topchiev Institute of Petrochemical Synthesis RAS (TIPS RAS), Moscow, Russia lebedev@ips.ac.ru

Microwave discharges are widely used for generation of non-equilibrium low pressure plasma for different applications. This paper reviews the methods of microwave plasma generation and general properties of microwave plasma (waveguide and cavity, surface and slow wave plasma generators, plasma generators with distributed energy input, initiated microwave discharges, wave beams discharges, ECR discharges). Plasma chemical activity of non-equilibrium microwave discharges is analyzed. Non-uniformity is the inherent property of majority of electrical discharges and microwave discharges are no exception. Reasons of non-uniformity of microwave discharges are analyzed. Peculiarities of physical-chemical processes in strongly non-uniform microwave discharges are demonstrated placing high emphasis on the influence of small gas additions to the main plasma gas. This problem is directly related to the possibility of using actinometry-method.

References

1. *The Applications of Plasmas to Chemical Processing* 1967ed R. F. Baddour and R. S. Timmins, Cambridge, Mass.: MIT Press
2. Lebedev Yu A *Chemistry of Nonequilibrium Microwave Plasma*  1998 *Plasma Chemistry* ed L S Polak and Yu A Lebedev Campbridge: Cambridge Interscience Publishing.
3. Lebedev Yu A 2010 *J. of Phys.: Conf. Series* **257** 012016
4. *Microwave Excited Plasmas 1992* ed M Moisan and J Pelletier, Amsterdam: Elsevier.
5. Moisan M and Pelletier J 2012 *Physics of Collisional Plasma. Introduction to High-Frequency Discharges*, Springer.
6. *“Strong Microwaves in Plasma”,* (1996, 1999, 2002, 2005) ed A. G. Litvak (Nizhny Novgorod: Institute of Applied Physics RAS)
7. *“Strong Microwaves: Sources and Applications”,* (2008) ed A. G. Litvak (Nizhny Novgorod: Institute of Applied Physics RAS)
8. *Strong microwaves and terahertz waves: sources and applications*", (2011, 2014) ed A. G. Litvak (Nizhny Novgorod: Institute of Applied Physics RAS)
9. *Microwave Discharges: Fundamentals and Applications Proc. NATO ARW* *(Vimeiro, Portugal, 11-14 May 1992)* *(NATO ASI, Series B: Physics* 1993 *vol 302)* ed C. Ferreira and M. Moisan (Ney York and London: Plenum)
10. *Microwave Plasma and its Applications* 1994 *Proc. Int Workshop* *(Zvenigorod, Russia, 5-8 September, 1994)* ed Yu. A. Lebedev (Moscow: the Moscow Phys Soc)
11. *Microwave Discharges: Fundamentals and Applications 1997 Proc.3 Int Workshop (Fontevraud, France, 20-25 April 1997)* ed C Boisse-Laporte and J. Marec (J de Phys IV 1998 vol 8 Pr7)
12. *Microwave Discharges: Fundamentals and Applications Proc. 4 Int Workshop* *(Zvenigorod, Russia, 18-22 September, 2000)* ed Yu. A. Lebedev (2001 Moscow: Yanus-K)
13. *Microwave Discharges: Fundamentals and Applications Proc. 5 Int Workshop* *(Greifswald, Germany, 8-12 July, 2003)* ed A. Ohl (Greifswald: INP)
14. *Microwave Plasma and its Applications Proc. 6 Int Workshop* *(Zvenigorod, Russia, 11-15 September, 2006)* ed Yu. A. Lebedev (2006 Moscow: Yanus-K)
15. *Microwave Discharges: Fundamentals and Applications Proc. 7 Int Workshop* *(Hamamatsu, Japan, 22-27 September, 2009)* ed M. Kando and M. Nagatsu.
16. *Microwave Plasma and its Applications Proc. 8 Int Workshop* *(Zvenigorod, Russia, 11-15 September, 2012)* ed Yu. A. Lebedev (2012 Moscow: Yanus-K)