THE INDUCTIVELY COUPLED R.F. PLASMA

Maher I. Boulos

Department of Chemical Engineering
Université de Sherbrooke
Sherbrooke, Québec, Canada J1K 2R1

While the first experiments on low-pressure electroless discharges can be traced back to the end of the nineteenth century, the atmospheric pressure induction discharge was only discovered in the fifties. In 1947, Babat [1] was the first to report that a ring discharge, once established at low pressure, can be maintained, while the pressure is raised up to atmospheric pressure.

The next major development which lead to the induction plasma as we know it today, is that due to Reed [2] in 1961. Reed's principal contribution was to show that an inductively coupled plasma discharge can be maintained in an open tube in the presence of a streaming gas. Upon leaving the discharge region, the partially ionized gas forms a low velocity plasma jet with an average temperature in the range of 8000 to 10000 K. Interestingly enough, in spite of the numerous investigations reported over the last twenty years, the basic design of the inductively coupled plasma torch hardly changed compared to that originally published by Reed.

Considerable progress, however, has been achieved in our understanding of the characteristics of such an important plasma generating device and its principal design and operation parameters. An excellent review on the subject has been published by Eckert [3] in 1974.

In this paper, a brief review will be made of the basic principals and the main design features of the inductively coupled plasma. This will be followed by a discussion of diagnostic measurements carried out by different investigators in order to determine the characteristics of the electric and magnetic fields, the temperature, velocity and concentration fields in the discharge region. Mathematical modelling will be discussed next, giving an overview of the different models proposed and typical results obtained.

Finally, applications of the inductively coupled plasma technology in such areas as material processing, synthesis of fine powders and spectrochemical elemental analysis will be discussed.

References