HIGHLIGHTS OF PREPARATIVE SOLID STATE CHEMISTRY IN LOW PRESSURE PLASMAS

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ABSTRACT

Plasma chemistry has, during the past years, developed into a well established interdisciplinary science as regards both fundamental research and applications. Unlike thermal plasmas, which have to date been successfully applied to physical tasks (e.g. plasma spraying, spheroidization, the production of finely dispersed powders and arc furnaces) rather than the chemical transformations, the low pressure, cold plasmas have been used to study a variety of chemical reactions and have become the basis of a number of technological processes.

Most of the work in cold plasmas was devoted to the heterogeneous solid-gas system. A notable exception to this is the ozone synthesis which, in spite of its relatively poor efficiency, seems to be the only ecologically acceptable alternative to chlorine for water treatment, bleaching and further applications.

With regard to industrial applications, the low pressure plasmas are being currently applied mainly to thin film deposition in the manufacturing of integrated microcircuits, optical fibres and protective coatings. Low deposition temperatures, sufficiently high deposition rates, excellent physical and chemical properties of the films and their good adherance to the substrate were recognized as the main advantages of the plasma technology. Whenever applied to the processing of highly sophisticated products in which the ratio of the final price to the amount of material deposited (or removed, as in etching) is high, the plasma techniques are also advantageous with regard to the economic aspects.

The preparation of hydrogenated, fluorinated and chlorinated amorphous and microcrystalline silicon is of large interest with respect to industrial applications as well as to basic research. Indeed, the successful demonstration of the substitutional doping of a-Si by Spear and Le Comber and, independently, by Carlson, et al. five years ago opened the way toward its applications in electronic devices (solar cells, rectifiers, and others) and attracted large attention to this material. The heterogeneous system Si/H-plasma is an excellent example of the variety and achievements of plasma chemistry.

The plasma assisted preparation of new materials or of known materials having new, unique properties, brings the plasma chemistry close to the field of solid state chemistry and physics. Further progress can, no doubt, be achieved only by combining sufficient

knowledge and experience from all the disciplines involved. Moreover, examples such as the synthesis of rare gas compounds and of complex compounds show that the preparative plasma chemistry can also bring new aspects and innovation to the true chemists who love the beauty of variety.