

## NEW FRONTIERS IN THERMAL PLASMA PROCESSING

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A growing interest in thermal plasma technology has recently manifested itself by a large increase in the number of US published patents in this field. A general literature search reveals particular interest in the plasma surface modification and coating technologies, plasma chemical synthesis and plasma waste treatment.

Surface modification and coating using thermal plasma technology is by far the most important of these three areas in terms of scientific maturity and economic activity. It covers such applications as the plasma spray coating of metals, ceramics and composites using atmospheric and low pressure plasmas, plasma diamond film deposition and other thin film coatings, using the PCVD and flash vaporization techniques.

Plasma chemical synthesis, has been the subject of substantial investigation for more than four decades with industrial scale applications maturing in the areas of acetylene production,  $\text{TiO}_2$  and high purity synthetic silica production, among others. Research efforts have also been maintained in the fields of ultrafine ceramic powder syntheses via the plasma route ( $\text{SiC}$ ,  $\text{Si}_3\text{N}_4$ ,  $\text{AlN}$ ) and the synthesis of Fullerenes ( $\text{C}_{60}$ ) which are still in various stages of development.

Waste treatment, is certainly one of the areas which bears lot of promise and where plasma technology can have an important impact. Research activities in this area are aimed at either the reclamation of waste material in order to recover higher added value products or the rendering to inert form or the destruction of toxic waste.

Progress on each of these three fronts as well as in other ongoing and potential industrial applications, will depend to a large extent on our understanding of the basic phenomena involved. This can only be achieved through systematic investigation on a solid scientific basis. While we have made important progress in the area of thermal plasma source development whether d.c. or r.f. induction generated plasmas, plasma and particle diagnostics and mathematical modelling, particular attention continues to be needed in the study of mass transfer phenomena involved under such relatively complex conditions. Attention is also to be given to the study of plasma-substrate and particle-substrate interactions during plasma spray coating processes. Early results indicate that these interactions strongly depend on the substrate temperature which in turn will have an important influence on residual stress distributions and other mechanical properties of the deposits. A serious lack of data presently exists for the wide range of possible chemical reactions that are potentially involved in most of the waste treatment applications. This is not only needed to insure complete destruction of the waste material treated, but also to avoid the formation of undesirable side products through uncontrolled back reactions.