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Pulsed Laser Deposition - A Review

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Pulsed laser deposition (PLD) had its origin in the early 1980's; however it came into prominence in 1987 with the first realization of thin films of high T_c superconductor $YBa_2Cu_3O_{3-x}$ (YBCO) using PLD. In the absence of a convenient technique for the growth of high quality films of multicomponent oxide materials, PLD has advanced phenomenally during the last two decades - first with the realization of thin films of high T_c superconductors, and subsequently of colossal magnetoresistance (CMR) and ferroelectric materials. The ability to realize high quality films from small targets has made the PLD technique extremely attractive for research laboratories. However, some disadvantages such as particulate formation and the difficulty in realizing films on large area substrates, have made PLD virtually limited to research laboratories.

This talk will review the physics and the kinetics of thin film growth by PLD and its progress since it was first used for YBCO film growth in 1987. From growth kinetics considerations, PLD is one of the most complex of the techniques, and yet, as experience has shown, it is the most convenient and versatile among the techniques for the realization of multicomponent compound (oxides, nitrides, etc.) thin films. This talk will review the impact of the PLD technique in the light of our own work (carried out first at TIFR since 1991 and now at CEN, IITB) in the realization of high quality films of high T_c superconductors, CMR materials, ferroelectrics and multiferroics. This talk will also highlight the contributions of PLD in the realization of some of our finest results such as highest J_c YBCO films, first synthesis of unstable $LuBa_2Cu_3O_{7-x}$ thin films, synthesis of ferroelectric $PbTiO_3$ films on <100> Si, and also the work on multiferroic $BiFeO_3$ films and $Bi_{0.6}Dy_{0.3}La_{0.1}FeO_3$ films which show coexistence of ferroelectric and magnetic ordering. Some work on PLD grown High-K dielectric films for possible device applications and also the recent work on room temperature based MEMS actuator devices using PLD grown multiferroic films will also be reviewed.

Acknowledgments:

Most of the early work was done at TIFR. Most recent work on High-K dielectric films, multiferroic films and devices has been carried out at CEN, Department of Electrical Engineering, IIT Bombay.