ION-BEAM-BASED METHODS FOR THIN FILMS DEPOSTION AND SYSTHESIS.

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During the last decade the surface treatment of materials has become a major development area in modern technology. Indeed, low energy ion bombardment of important tool in modifying the resultant film properties.

In most conventionnal depostion techniques, in general, films are grown under highiy non-equilibrium conditions which are unlike the conditions characterising the solidification of the solide from the melt. These non-equilibrium conditions during film growth result in the formation of lattice vacancies and pores. One non-equilibrium approach to reduce the defect formation during growth process is to supply additional excitation to the adatom or sustrate through some surface interactions, whilst keeping the bulk of growing film at low temperature. Supplying additional energy to the adatom on the growing film (e.g. energetic particle bombardment) increases the surface mobility of adatoms, displaces surface and bulk atoms, and supplices enough activation energy for chemical reations to occur. Consequently, the physical and chemical properties of films can be greatly modified.

This review describes ion-beam-based methods for production of thin films or modified layers. First, the different techniques are discussed and exemples are given of surface modified layers produced using systems where energetic bombardment and deposition of film material occurs. Finally, results for deposition of TiN_x films using a dual ion beam system are briefly discussed.

It has been found that the composition of these films is dependent upon the deposition parameters and ion species with the nitrogen to titanium concentration ratio ranging from 0.65 to 1.45. TEM studies indicated the films are polycrystalline fcc TiN single phase, with preferred(100) orientation.

The degree of preferential (100) orientation increases with increasing added ion energy density. The highly oriented TiN regions with (100) orientation begin to decrease with further increase in added ion energy density above some critical value. The (100) preferential orientation does not appear to be influenced strongly by the crystal structure of the substrate in the present work.

The compositional data has been explained in terms of a new model. This explains the compositional changes in terms of the sticking probability of thermal nitrogen on the film, ion-enhanced sticking probability of nitrogen, preferential sputtering yields, and nitrogen implantation effects.