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The advancing techniques and sputtering effects of oxide films fabricated by Stationary Plasma Thruster (SPT) with Ar and O_2 gases

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The usage of a stationary plasma thruster (SPT) ion source, invented previously for space application in Russia, in experiments with surface modifications and film deposition systems is reported here. Plasma in the SPT is formed and accelerated in electric discharge taking place in the crossed axial electric and radial magnetic fields. Brief description of the construction of specific model of SPT used in the experiments is presented. With gas flow rate 39 ml/min, ion current distributions at several distances from the source are obtained. These was equal to 1~3 mA/cm^2 within an ion beam ejection angle of $\pm 20^\circ$ with discharge voltage 160V for Ar as a working gas. Such an extremely high ion current density allows us to obtain the Ti metal films with deposition rate of 3.2 Å/sec by sputtering of Ti target. It is shown a possibility of using of reactive gases in SPT (O_2 and N_2) along with high purity inert gases used for cathode to prevent the latter contamination. It is shown the SPT can be operated at the discharge and accelerating voltages up to 600 V.

The results of presented experiments show high promises of the SPT in sputtering and surface modification systems for deposition of oxide thin films on Si or polymer substrates for semiconductor devices, optical coatings and metal corrosion barrier layers. Also, we have been tried to establish in application of the modeling expertise gained in electric and ionic propulsion to permit numerical simulation of additional processing systems. In this mechanism, it will be compared with conventional DC sputtering for film microstructure, chemical composition and crystallographic considerations.