In this paper, a systematic study for the correlation of electrical parameters of the Tungsten plasma with ion energy distributions and deposition rate is presented. Tungsten films were deposited on stainless steel substrates for different plasma conditions. Thermal shock assessment was undertaken for all the films deposited under these conditions. Adherence tests were also performed for all samples.

The deposition method used in this study was Thermionic Vacuum Arc (TVA) ignited in Tungsten vapors. The TVA deposition method briefly consists in obtaining a plasma in the vapors of the material to be evaporated. The vapors are obtained by heating the material with thermo electrons generated by an externally heated filament. The plasma is localized above the anode. The ions created in this plasma are accelerated towards the chamber walls (and subsequently towards the substrate) due to the potential difference between the plasma and the grounded walls. The energy of ions is directly proportional to this potential difference. This is an important feature of the method, as ion energy can be relatively easily controlled by external parameters.

In plasma deposition, plasma diagnostic techniques are essential for understanding the process parameters. Ion energy and deposition rate are key parameters for technological control.

An in-house, computer-controlled RFA analyzer was used for determination of ion energy distributions in these plasmas. The retarding field analyzer (RFA) is an electrical probe capable of providing ion energy distributions in plasmas. It was found that the ion energy increases with the power introduced into the system and it also decreases with decreasing filament current. The deposition rate was also measured for different values of plasma parameters using a computer-assisted Cressington gauge. A relative measurement of film adherence using a computer-assisted pull-off test equipment was also used.

A clear picture of the optimal TVA plasma conditions for the highest adherence and also for the highest thermal shock is presented.