

The microelectromechanical systems, known as MEMS, have been in the past few years an authentic revolution in microelectronics; they are based on the interaction between mobile parts and electrical signals in the micrometer scale. Furthermore, researchers try to develop MEMS devices which could be fabricated with mainstream CMOS technology, making them interesting in the technology market.

There are many types of MEMS devices, but in this work we have concentrated on microelectromechanical switches. The main applications of MEMS switches are in the radio frequency area, as filters and phase shifters, or more recently in the optics area, such as mobile display.

The microelectromechanical switches have many advantages compared to conventional devices, such as low power consumption, linearity and low loss, but their commercialization is hindered by reliability problems. The MEMS lifetime is determined by mechanical and electrical problems, where *dielectric charging* is the most important, based on the charge trapped inside the dielectric that avoids a short-circuit when the switch is actuated.

In order to study the dielectric charging problem, several types of microelectromechanical switches have been designed and fabricated with two different dielectric materials: thermally grown silicon dioxide and plasma assisted deposition of silicon nitride. These dielectrics show different physical properties that help to quantify the switches reliability. The fabrication process is based on surface technology by placing different layers patterned to provide the final device.

The MEMS process is limited by the sacrificial layer that forms the final beam shape, which is considered as a critical point. Thus, a new process based on a commercial photoresist has been developed that makes easier the fabrication itself and reduce costs.

The charge effects shown by the microelectromechanical switches are similar to those related to MOS gate problems investigated years ago. Thus, by using the same physical theory, we have developed a novel theory based on a dynamic model that uses the transient current to extract the dielectric physical properties and quantify the microelectromechanical switch. Furthermore, this theory is also used to study the reliability concerning different actuation modes.

The test procedure consists in applying different voltage and current values and measuring the charging and discharging current. The discharge current provides information about the amount of charge trapped in the dielectric, trap energy level and the dielectric conductivity. These parameters have been used to create a novel figure of merit that provides a reliability parameter based on the dielectric and type of actuation used.