

Modeling of Dielectric Charging in RF MEMS

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Abstract: An insulator, by definition, carries no conduction current. Practical insulators (e.g. oxide) however seem to not know the definition and as voltages are ramped across them, charges injected from the electrodes accumulate within the oxide, and change their capacitive response in unpredictable ways. The problem of dielectric charging has long been discussed in wide variety of contexts and to this day continue to dictate the material choice in many electronics applications. Indeed, given the history of technological relevance in electronics industry, scientists have worked hard to understand dielectric charging in gate oxides and perovskites for electronic applications. And there is a general perception that the basic mechanisms of the charge injection/accumulation processes are reasonably well understood and that the performance of the oxide – including the charging effect – may be predicted with reasonable certainty over a prolonged period of time. Unfortunately, the dielectric charging in RF-MEMs can still not be described by a comparably predictive model, as it has been difficult to characterize the additional complexity of oscillating electrode making only a fleeting, non-uniform, yet harsh contact with the oxide per cycle. In this talk, we will explore the basic elements of dielectric charging problem specific to RF-MEMs switches and explain our initial attempts to encapsulate these elementary concepts into a simple phenomenological model. The principle of dielectric charging in RF-MEMs is shared by many other devices of scientific (e.g., AFM) and technological (NEMs based non-volatile memory) interest, and therefore we anticipate that even a simple and phenomenological model may be of broad interest to the electronics community.



Bio: MUHAMMAD ASHRAFUL ALAM is a Professor of ECE at Purdue University where his research and teaching focus on physics, simulation, characterization and technology of classical and novel semiconductor devices. From 1995 to 2003, he was first with Bell Laboratories, Murray Hill, NJ, as a Member of Technical Staff in the Silicon ULSI Research Department and then a Distinguished Member of Technical Staff at Agere Systems, Murray Hill, NJ. He joined Purdue University in 2004. Dr. Alam has published over 100 papers in international journals and has presented many invited and contributed talks at international conferences. He is a fellow of IEEE and APS, a Distinguished Lecturer of Electron Device Society, a member of Sigma Xi, and recipient of 2006 IEEE Kiyo Tomiyasu Award for contributions to device technology for communication systems.