RADIO FREQUENCY MICRO-ELECTRO-MECHANICAL SYSTEMS (RF MEMS)

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The advances in the semiconductor technology in the past three decades have allowed to place millions of transistors into a single chip. These developments and microelectronics technology have resulted in a big impact and advances in Information Technologies, integrated circuits has become a part of our daily life, and it has become possible to implement very complicated control algorithms in a small area as an integrated chip at very low cost. Although microelectronic technology has allowed to reduce the cost of electronic circuits, the parts that provide an interface between analog world and electronics, such as sensors and actuators, started to determine the cost of the systems. There has been an extensive efforts in the recent years to decrease the cost of the systems, and the solution is found by implementing the other systems components using semiconductor technology. This approach allows to implement all the electronics and mechanical parts on the same chip. This technology is called as Micro-Electro-Mechanical Systems, or shortly MEMS.

Many disciplines have started to use the MEMS technology for their own applications. One of the disciplines that started to use MEMS technology is electromagnetics and radio frequency field, and this interaction has lead to a new concept called RF MEMS. RF MEMS allows to develop special circuit components that help to enhance performance of RF circuits and systems. For example, RF MEMS allows to implement micro mechanical filters with extremely high Q values. This makes it possible to implement all of the RF receiver/transmitter circuit components on a common substrate together with electronic components, both reducing the system size and decreasing the system cost. Also, it is possible to implement micro mechanical switches for RF applications with low insertion loss when it is ON and high isolation when it is OFF in this technology. In general, RF MEMS allows to produce low cost, low power consumption, low weight, and small volume systems. These properties make it possible to run low power communication systems with even lower power and higher efficiency. Due to these reasons they have important application areas in communication systems, including space applications.

Considering its wide applications in RF systems, a collaboration work is started between Microwave Group and MEMS Group at METU to develop critical RF circuit components using MEMS technology[1]. The collaboration work started with an extensive literature survey to develop the background at METU and to establish a database on RF MEMS. Based on this knowledge, some new RF MEMS structures was designed, their operation was theoretically verified using simulations on HFSS and MEMCAD software programs. In addition, a new standard process based on surface micromachining on glass substrates has been established. A number of RF MEMS components are implemented with this process, including RF MEMS switches, phase shifters, impedance matchers, and phased array antennas. The RF MEMS process at METU is mature enough to allow other users from other universities and research centers to present their designs for fabrication at METU-MEMS facilities.

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