

DESIGN, ANALYSIS AND DYNAMIC PHENOMENA OF MEMS CAPACITIVE POWER HARVESTER

Jianxiong Zhu

Dr. Frank Feng, Dissertation Supervisor

ABSTRACT

Unwanted vibrations are all around us in our daily life. These vibrations can effectively be converted into electrical power through capacitive device. Even though the amount of power generated is small (μW), it is still sufficient to drive certain devices, such as devices in the field of Micro Electro Mechanical System (MEMS). We call these functional devices “self-powered devices”. This dissertation describes design, modeling, analysis, dynamic simulation and experimental testing of MEMS variable capacitors which are used for power harvesting based on external vibration. More specifically, it includes the electrostatic force and the forces provided by the stopper designed to prevent direct impact between capacitive plates. To more accurately reflect the status of power harvesting, rocking instability is discussed as well. However, the onset of rocking instability leads to more complicated dynamic phenomena. This dissertation not only introduces equation theory derivation and dynamic behaviors of the MEMS capacitive harvester, but also presents a comparison of power harvesting at broad frequencies and different amplitudes. These conclusions are helpful for the design of high efficiency “self-powered” MEMS capacitive power harvester.