Compressive Beam for a Bistable MEMS Memory Element

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Abstract

Innovations in microelectromechanical systems (MEMS) devices, micrometer-scale machines that combine electrical and mechanical elements, allow for MEMS memory to be a viable replacement for flash memory, a memory commonly used in consumer electronics such as cellphones. MEMS memory based on buckled stress can be competitive with semiconductor flash memory, due to its similar size, smaller write voltage, faster write time, and smaller write energy. The design concept of this project includes a fixed-fixed beam that will buckle under compressive stress, either in the up or down direction, to write a 1 or 0, respectively. Electrodes are placed above and below the buckled beam for reading and writing, and a voltage pulse can be applied to the buckling beam, which will induce current in each electrode. The electrode closest to the beam will have a higher capacitance and therefore a larger current. A sense circuit can be used to determine the largest current produced between both electrodes, resulting in the value of the bit. The process flow for fabricating the device began with an oxidized silicon wafer, which then had titanium-tungsten (TiW) deposited onto its surface. The TiW deposition process had to be optimized to obtain a suitable compressive film. Afterward, photolithography was performed to create the desired fixed-fixed beam pattern, which was used to etch away at the TiW. Additionally, the use of anhydrous hydrogen fluoride released the beam by etching the silicon dioxide underneath it.

Biography

My enthusiasm for engineering sparked in the 7th grade when I was introduced to the field through the Math, Engineering, Science, and Achievement program at my middle school. I am currently studying Electrical Engineering at the University of Wisconsin-Madison, and I plan to study abroad in Spain while working towards completing a certificate in International Engineering. I have been awarded the Posse scholarship, a merit-based, full-tuition scholarship, as well as the Edison International scholarship. The College of Engineering has named me a Leader in Engineering Excellence and Diversity (LEED) scholar. In my spare time, I work as a student advisor for the Vice Provost of Teaching and Learning and the Immigration and International Issues committees. I am also a writer for the Wisconsin Engineer Magazine.