RF NEMS Magnetoelectric Sensor Simulation and Demenstration

H. Lin[1], N. Sun[1], N. X. Sun[1]

[1]Northeastern University, Boston, MA, USA

Abstract

RF NEMS Magnetoelectric (ME) Sensor with a ferromagnetic (FeGaB)/ piezoelectric (AlN) thin film heterostructure is simulated, fabricated and measured in this work. To analyze the response of the ME structures, the coupling between the magnetic, elastic and electric field in the two different magnetostrictive and piezoelectric effects should be taken into consideration. Simulations with FEM software, COMSOL® were carried out to investigate the frequency response analysis by existing modules which are magnetic fields, solid mechanics, and electrostatics modules. The ME composites were constructed into magnetostrictive, piezoelectric phase and air subdomain and performed with the frequency domain in 3D geometry to illustrate the modeling principles for more complicated problems. The ME sensors was fabricated using a five-mask CMOS compatible microfabrication process. The RF magnetic field is generated by a RF coil soldered on SMA port and connected to the out-put port of the lock-in amplifier. The simulation of direct Magnetoelectric coupling induced voltage generated by ~60 nTesta RF magnetic field was about 118μV which was comparable to the experimental results 180μV at ~60MHz. The Direct Magnetoelectric coupling simulation capability by COMSOL® is expected to have great impacts on our future communication systems for internet of things (IoT), wearable sensors, bio-implantable and bio-injectable sensors, smart phones, wireless communication systems, etc.

Figures used in the abstract

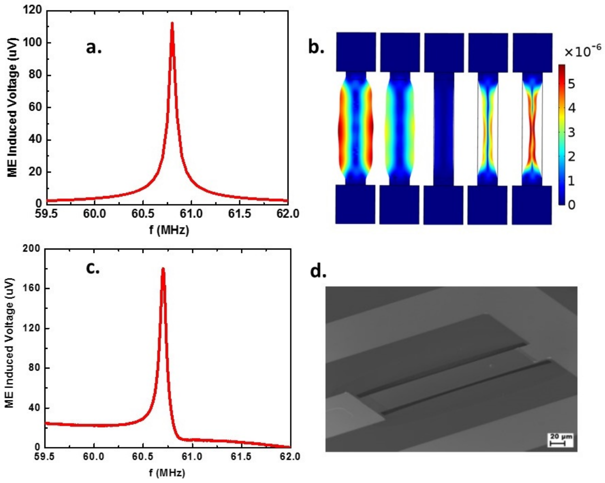

Figure 1: (a). Simulated ME induced voltage. (b). Simulated displacement Profile. (c). Measured ME induced voltage. (d). SEM image of the ME sensor