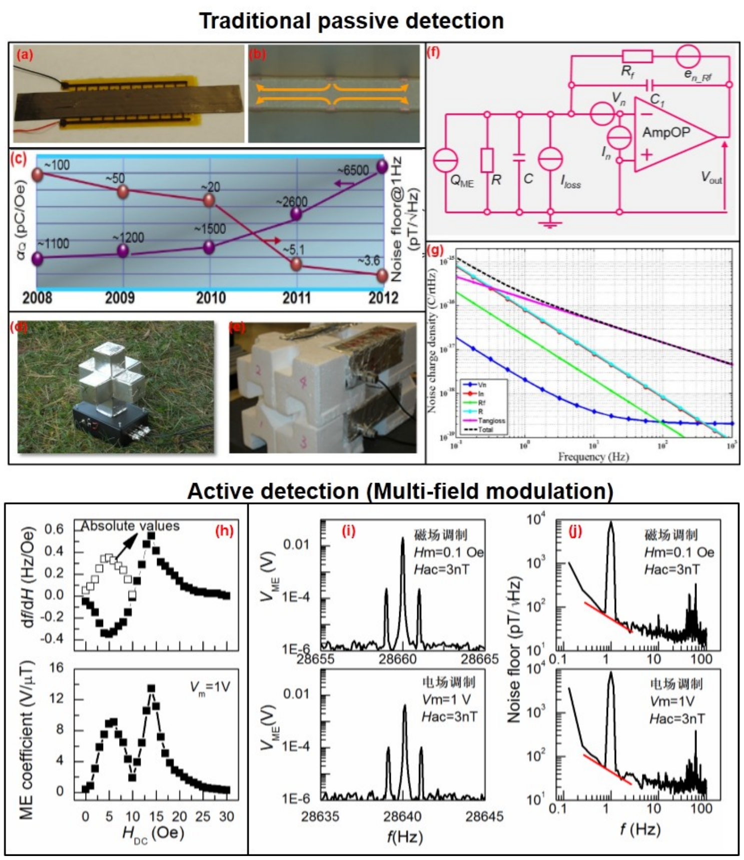
# Equivalent Magnetic Noise of Heterostructural Magnetoelectric Sensors

Yaojin Wang
School of Materials Science and Engineering, Nanjing University of Science and Technology, Nanjing 210094, Jiangsu, China
* Yaojin Wang: yjwang@njust.edu.cn

The magnetoelectric (ME) effect has attracted significant interest in recent years due to potential multifunctional devices applications such as passive magnetic field sensors, non-volatile electric-write/magnetic-read memories, etc. In particular, giant ME coupling found in Metglas/piezofiber laminate composite open the possibility of magnetic field sensors applications. The practical usefulness of a magnetic sensor is determined not only by the output signal of the sensor in response to an incident magnetic field, but also by the equivalent magnetic noise generated in the absence of an incident field[1]. The challenge of fabricating a ME composite with a high ME coefficient $\alpha_E$ and a low equivalent magnetic noise has restricted the realization of ME magnetic sensors. There have been limited reports on ME sensors that exhibit low frequency ($f$<10 Hz ) equivalent magnetic noise levels on the orders of 20 pT $Hz^{-1/2}$ range, which is still between one and two orders larger than that of optically pumped ultralow magnetic field sensors[1]. The reduction of equivalent magnetic noise is perhaps the most difficult technical obstacles to practical use of ME magnetic sensors. Hence, a theoretical analysis of noise sources, and evaluation of resultant equivalent magnetic noise of each source, is crucial for a complete understanding of ME magnetic sensors. Studies of the constituent noise sources, and the corresponding equivalent magnetic noise, have previously been deficient, in particular with regards to the relative magnitude of the equivalent noise.




In the workshop, I will present the imperative theoretical modeling of various noise sources in ME sensors[2,3]. In particular, the magnitude of the noise sources will be discussed, and the main noise source can be found for various mode ME sensors. In turn, the equivalent magnetic noise was significantly reduced in Metglas/piezofiber sensors based on the theoretical modeling. An extremely low equivalent magnetic noise (5 pT √ Hz @ 1 Hz) ME sensor was achieved, in which the $\alpha_E$ was as large as 55 V/cm˙Oe at optimal bias field of Hdc= 8 Oe, and the magnetic field sensitivity was as high as 10 pT at 1 Hz[4].

**References**:
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