

# Impedance Spectroscopy for MEMS based Sensors

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**Abstract:** Impedance Spectroscopy is a popular analytical tool for analysis of material electrode interface since the application involves a simple electrical measurement but can be used to study many complex material variables such as mass transport, corrosion, chemical reactions, dielectric properties and others. This technique has the inherent potential of non-destructive testing, single side access of MEMS based sensors and label-free detection for biological and chemical analysis. The impedance of a system is determined by applying a small signal perturbation as a function of frequency and analyzing the resultant current through the system in terms of amplitude and phase shift compared to voltage-time function. The complex value of impedance can thus be described in terms of its real and imaginary values at different frequencies. The results of an impedance measurement can be graphically demonstrated using bode and Nyquist or Cole-Cole plot for all applied frequencies. The consequent impedance spectrum thus obtained, allows the characterization of surface, layers and concentrations in addition to the exchange and diffusion processes describing the system kinetics. This is achieved by analyzing the impedance spectrum on basis of an equivalent series/parallel circuit commonly consisting of resistances and capacitances representing the different electrochemical and physiochemical properties of the system under analysis. In this presentation, I will present our research on impedance techniques of MEMS based planar electromagnetic sensors for two different applications: (i) Detection of pathogen in meat and (ii) Phthalates detection in water and juices.

## **A short biography of Subhas Mukhopadhyay**

**Biography:** Subhas holds a B.E.E. (gold medallist), M.E.E., **Ph.D.** (India) and **Doctor of Engineering** (Japan). He has over 24 years of teaching, industrial and research experience.

Currently he is working as a Professor of Sensing Technology, Massey University, New Zealand. His fields of interest include Smart Sensors and sensing technology, instrumentation techniques, wireless sensors and network, numerical field calculation, electromagnetics etc.

He has published over **280** papers in different international journals and conference proceedings, written two books and twenty five book chapters and edited **Eleven** conference proceedings. He has also edited **fifteen** books with Springer-Verlag and **Eleven** journal special issues. He has organized many international conferences as either General Chairs/co-chairs or Technical Programme Chair. He has delivered **195** presentations including keynote, invited, tutorial and special lectures.

He is a **Fellow** of IEEE (USA), a **Fellow** of IET (UK), a **Topical Editor** of IEEE Sensors journal, an **associate editor** of IEEE Transactions on Instrumentation and Measurements, and a **Technical Editor** of IEEE Transactions on Mechatronics.

He is a **Distinguished Lecturer** of the IEEE Sensors Council. He **chairs** the IEEE IMS Technical Committee 18 on Environmental Measurements.

More details can be available at <http://seat.massey.ac.nz/personal/s.c.mukhopadhyay/>