

A new methanol concentration microsensor for improved DMFC performance

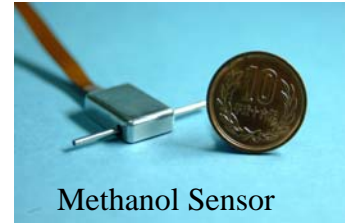
D.Sparks+, C.Laroche, N.Tran, D.Goetzinger, N.Najafi, K.Kawaguchi*, M.Yasuda*

Integrated Sensing Systems, Inc. (ISSYS)
Ypsilanti, MI 48198, USA

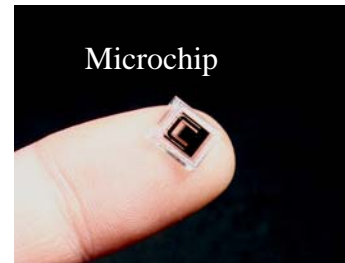
+ contact info: tel 734-547-9896 ext 119, dsparks@mems-issys.com, www.mems-issys.com

*Kyoto Electronics Manufacturing Ltd (KEM)
Kyoto, 601-8317, Japan

ISSYS and KEM are developing a methanol concentration sensor based on micromachine or MEMS (MicroElectroMechanical Systems) technology. Using an embedded methanol sensor in an active DMFC (Direct Methanol Fuel Cell) can improve cell performance and make such systems commercially viable. This new sensing chip has better sensitivity over the full range of concentration and temperature than any other technology. It is also insensitive to common impurities and by-products found in DMFC systems.



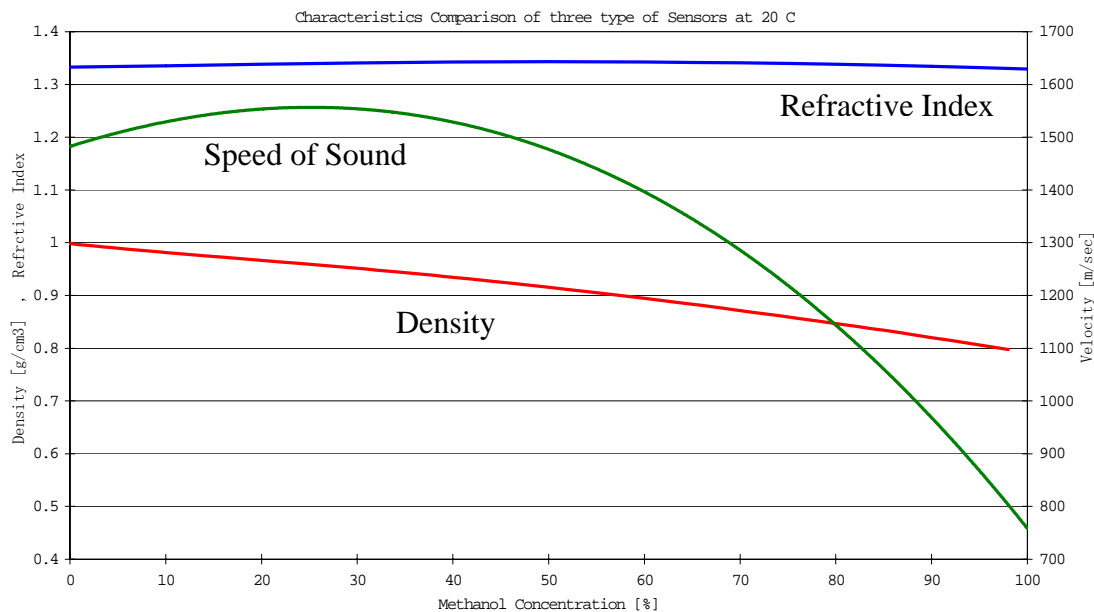
Methanol Sensor



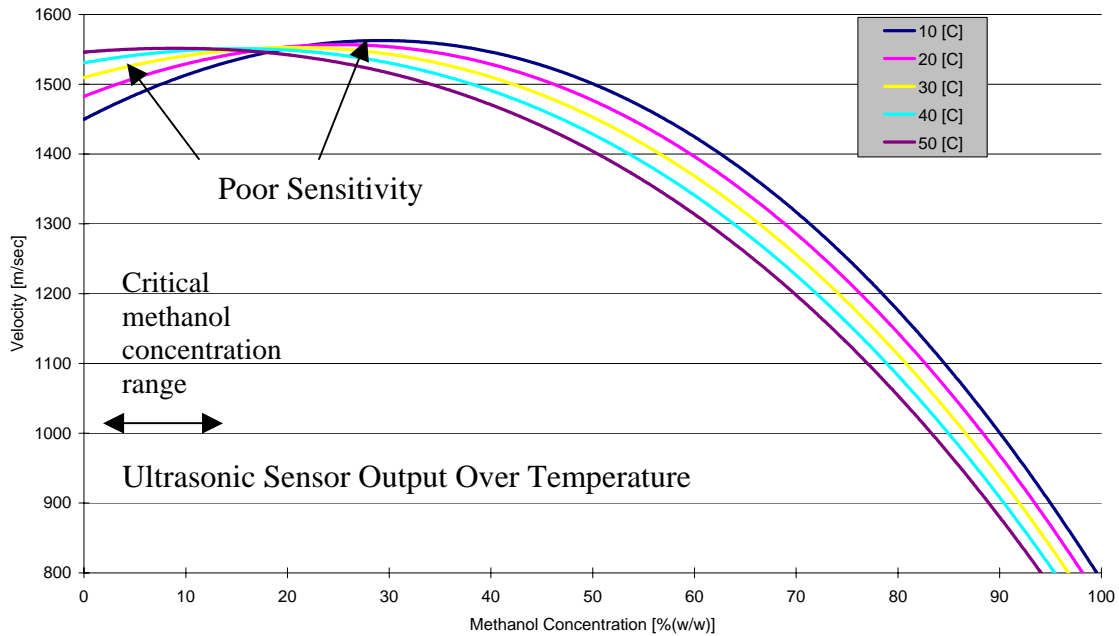
Microchip

Based in an industrial, in-line density meter design that has been on the market for several years, the methanol concentration sensor has been well characterized over temperature and density.

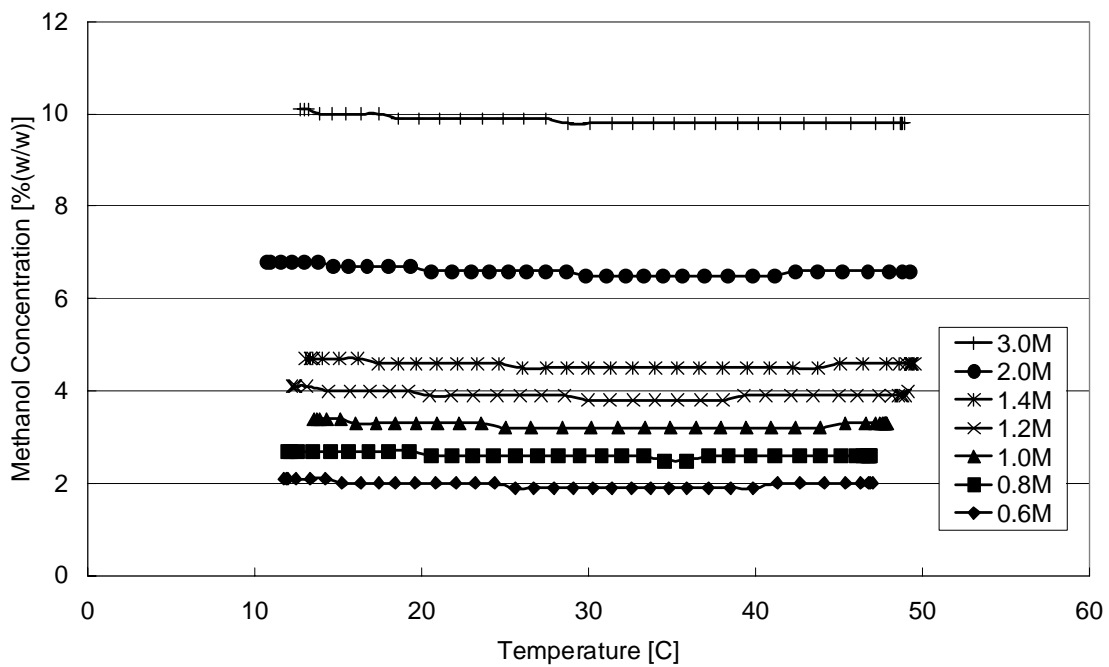
Unlike other technology, like ultrasonic (speed of sound) or refractive density sensing technique has a good sensitivity over the full rang



Ultrasonic sensors have problems with changes in output slope and sensitivity that vary with temperature. Sensitivity is severely degraded at 50°C in the critical, low methanol



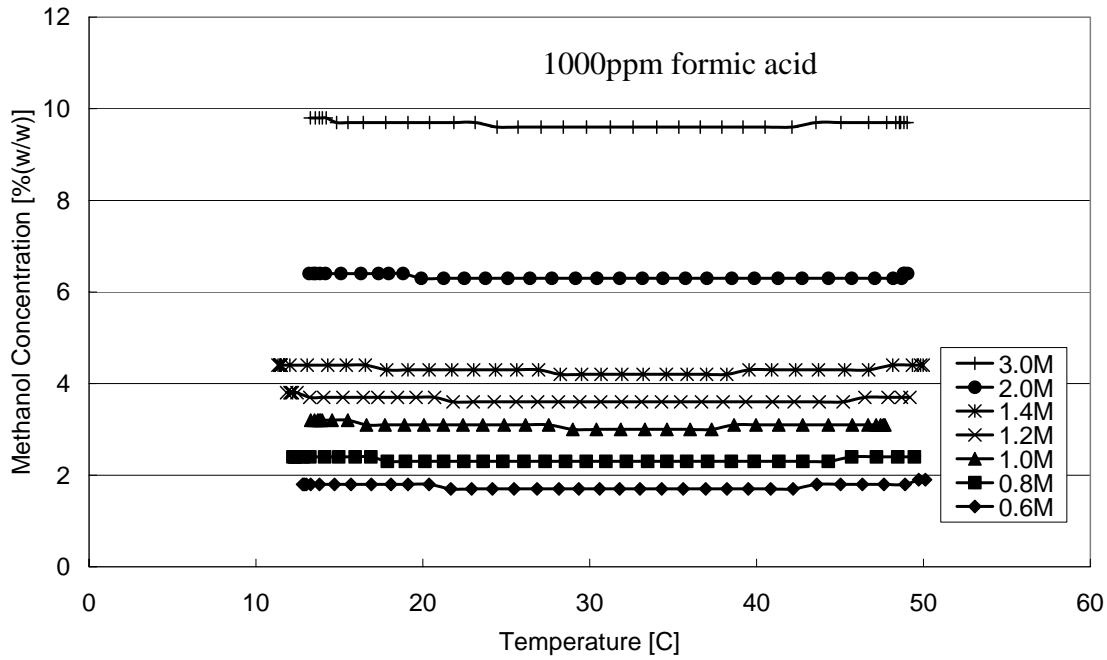
concentration region. Methanol concentration over temperature can be obtained reliably using a mass-based density sensor as shown below for a wide range of methanol to water concentrations.



Another benefit of using the density sensor technology is the virtual immunity of the technique to low concentrations of DMFC reaction by-products. The following table shows how the sensor output varied with different concentrations of formic acid. Typical methanol DMFC systems will have formic acid concentrations of up to 100 ppm. Electrochemical concentration sensors will have problems with such impurities.

Methanol Concentration	Measured Methanol Concentration with formic acid			
	0 ppm FA	50 ppm FA	100 ppm FA	1000 ppm FA
About 0.6 mol / L	2.0	2.0	2.0	1.8
About 0.8 mol / L	2.7	2.7	2.7	2.3
About 1.0 mol / L	3.4	3.3	3.3	3.1
About 1.2 mol / L	4.1	4.0	4.0	3.7
About 1.4 mol / L	4.7	4.7	4.7	4.3
About 2.0 mol / L	6.8	6.7	6.7	6.3
About 3.0 mol / L	10.2	10.1	10.1	9.7

The following plot shows that the good temperature performance of the methanol sensor is not affected by 1000 ppm formic acid by-products.



For more information on these patented methanol sensors for embedded DMFC applications contact: Doug Sparks, Integrated Sensing Systems, Inc., ISSYS, 391 Airport Industrial Dr., Ypsilanti, MI 48198, USA, tel 734-547-9896 ext 119, dsparks@mems-issys.com, www.mems-issys.com

