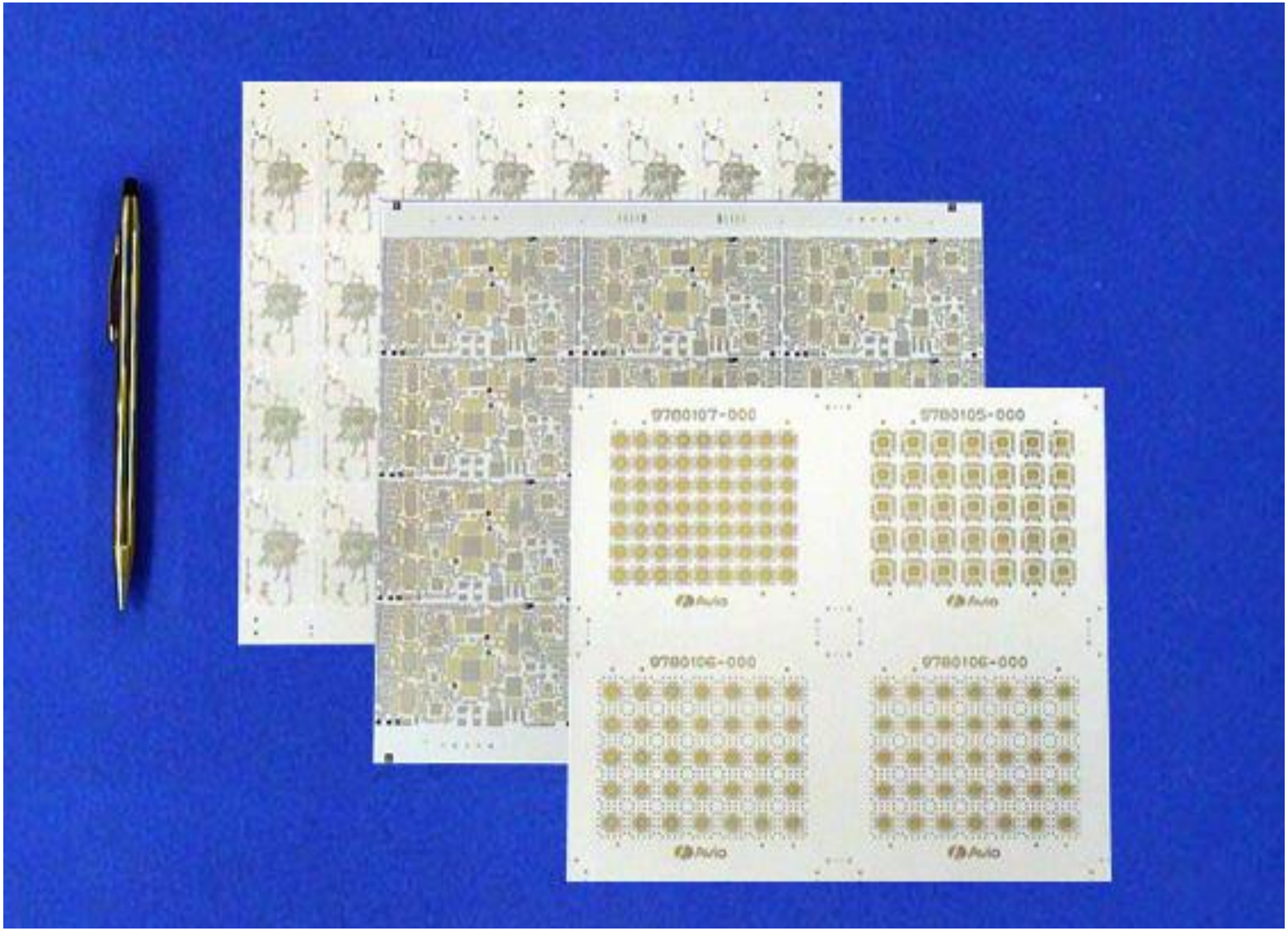
Low temperature Co-fired Ceramics.

This is muRata's exotic LTCC



What is LTCC?

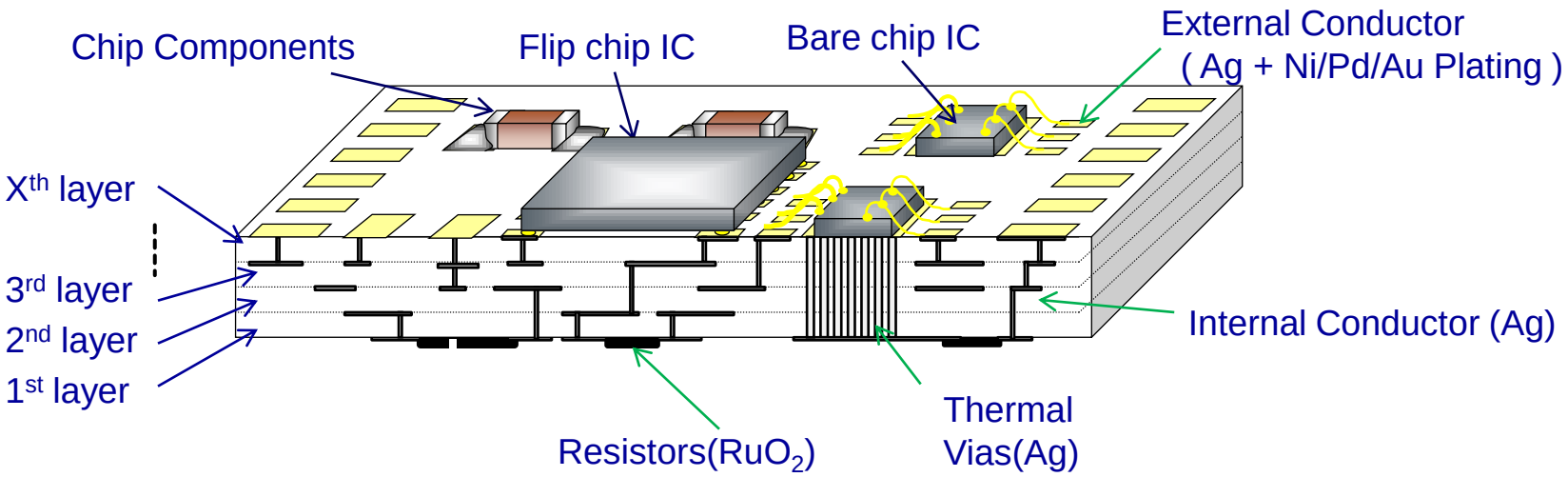
"LTCC" stands for Low Temperature Co-fired Ceramics

	muRata LTCC	HTCC
Major Materials	Glass + Alumina	Alumina
Conductor & Via Materials	Ag	W or Mo
Firing (Sintering) Temperature	Below 1,000℃	1,500 ~ 1,600℃
Features	✓ Excellent high frequency signal transmission – Ag via ✓ Zero Shrink sintering	✓ High thermal Conductivity

Features

➢ Large size panel	8" x 8" panel
➢ High Dimensional Accuracy	Dimensional tolerance ±0.1%
➢ Plating available	Ni-Pd-Au or Ni-Au electroless plating
➢ Embedded passive functions	～100pF、～100nH
➢ Resistor printing	Accuracy ±1% after trimming, TCR±100ppm, 20-100KΩ square

LTCC Outline



- ✓ LTCC Material：Composite of Glass(CaO-Al_2O_3-B_2O_3-SiO_2) & Alumina(Al_2O_3)
- ✓ Features: Low Temperature Firing (< 900℃, Alumina=1,500℃)

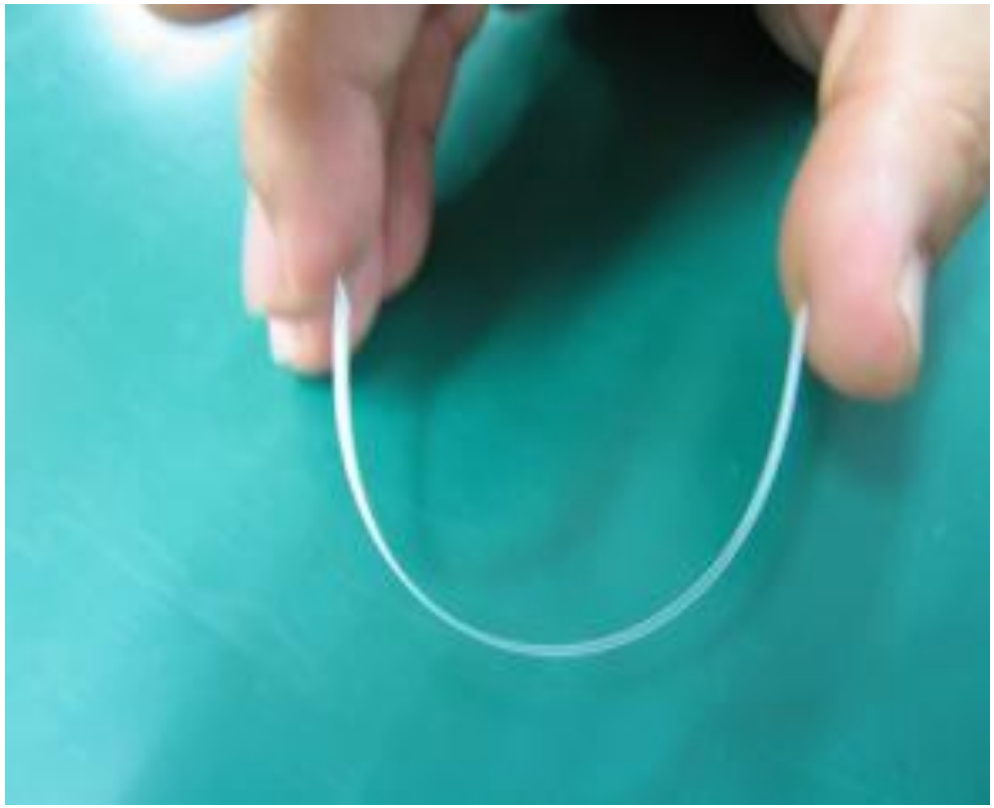
  Inner electrode is Ag.

  Ag filled thermal via.

  Surface electrode is Ag+ Ni/(Pd)/Au electroless plating.

  Non hazardous materials like Pb, Cd, Hg, etc.

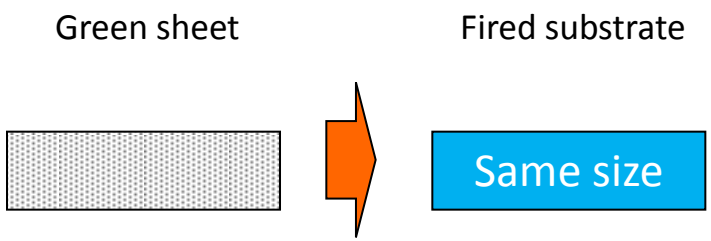
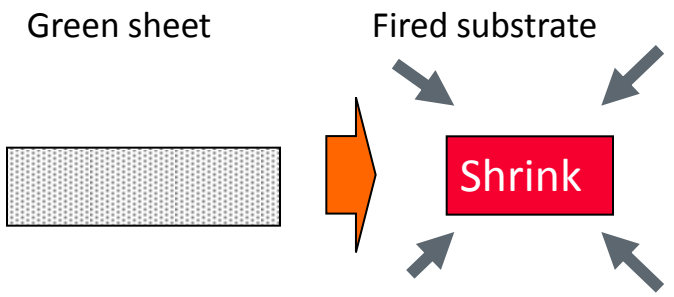
Seeing is believing



0.075mm t (5mm W x 100mm L)

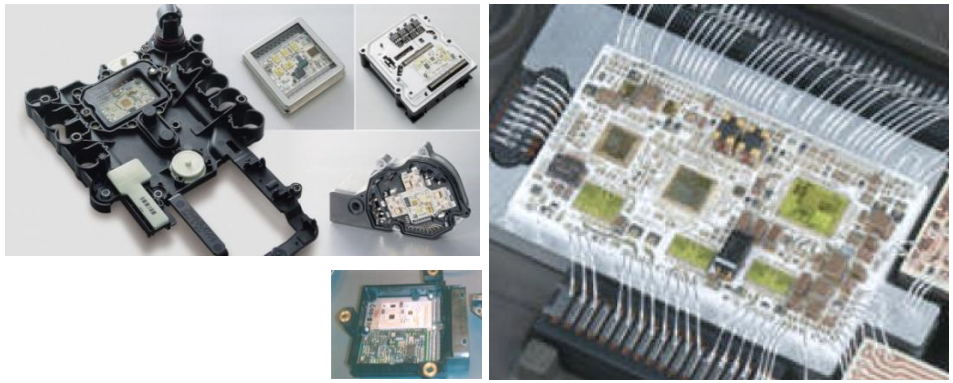
Comparison – vs Alumina

✓None shrinkage firing vs shrinkage firing

Murata LTCC none shrinkage firing	HTCC shrinkage firing
Non shrinkage firing ✓ No shrinkage of panel areas in X&Y but about 50% in Z direction. ✓ Same electrode dimensions as printed. 	**Non Constraint firing** ✓ Substrates shrink by about 20% in X&Y direction. ✓ Dimensions will become 60% of original size. 
Dimensional Accuracy after firing : +/-0.1% **Flatness after firing : Excellent** **Green sheet size : Large-8”x8”**	**Dimensional Accuracy after firing : +/-0. 5%** **Flatness after firing : Poor** **Green sheet size : small-around 4”x4”**

Typical Application

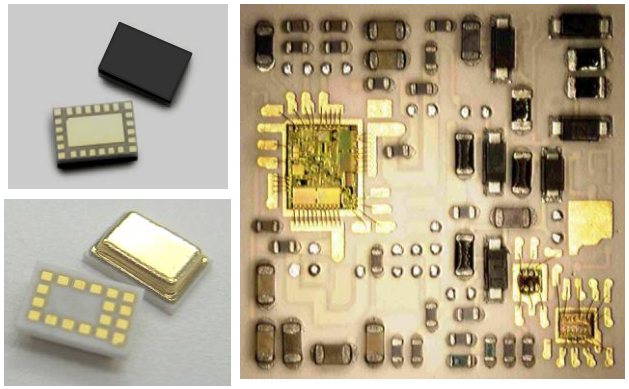
Automotive Power Train



LFC for ESC(1”x2”)

LFC➔ Low temperature Fireable Ceramics

Communication device

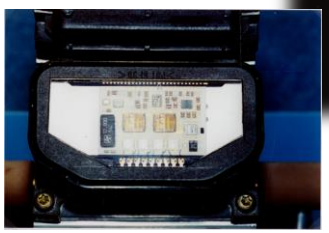


AWG for FEM(10x10mm)

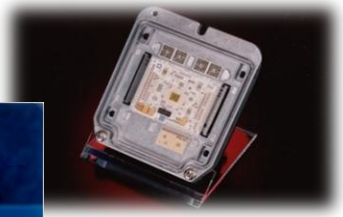
AWG➔ Alumina Wollastonite Glass

History of Automotive application （LFC）

ABS = Anti-lock Braking System
EMS = Engine Management System
EPS = Electronic Power Steering
TCU = Transmission Control Unit



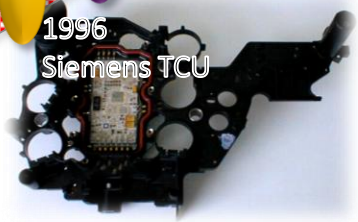
1995 - XXX ABS



1985.11
LFC - Release at Conference

1983.6
LFC - Start of Development

1997
Siemens EMS



1999
Motorola EMS

1997.12
Zero-Shrink Technology

2002 – Siemens TCU (Ver.1)

2004
Bosch ABS & EPS

2004 – Siemens TCU (Ver.2)

2005
Motorola TCU

2006 – Siemens TCU (Ver.3)

2007 – Siemens 6AT TCU

2008
Continental 6AT (Ver.1)

2008
Continental 6AT (Ver.2)

2009
Continental DCS TCU

20
Continental 6AT (Ver.3)

2008
Bosch EPS (Ver.2)

XXX EPS (2008)

XXX ABS (2004)

XXX EPS (2004)

Motorola TCU (2005)

Potential Applications in Car Electronics

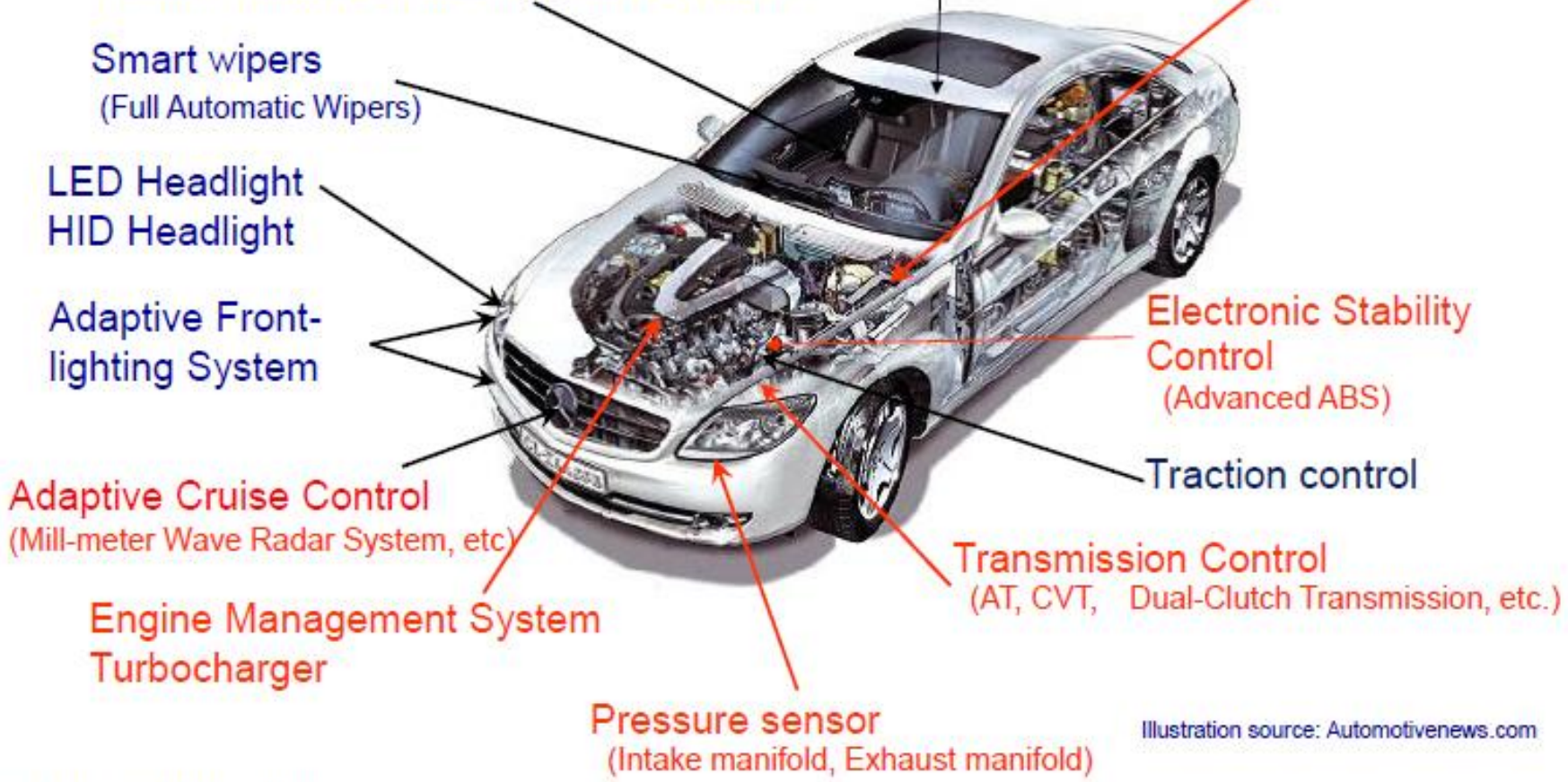


Illustration source: Automotivenews.com

Additional potential …… ,
Active suspension, EMS + Battery management for HEV, Common-rail system for GAS engine

LTCC Substrate technology

- Already having business with Continental for TCU application.

- Many possibilities to utilize such cutting edge technology for non power train applications like:

  – HID unit, radar/ Antenna modules,..etc (RF Applications)

  →Miniaturization, High integration, robust performance.

Thank you very much for your attention!