26th World Gas Conference

1 – 5 June 2015, Paris, France

New Gas Quality Sensor for « Mass Market » Applications

Dr. Philippe Prêtre
MEMS AG, Switzerland

WGCPARIS2015
WORLD GAS CONFERENCE

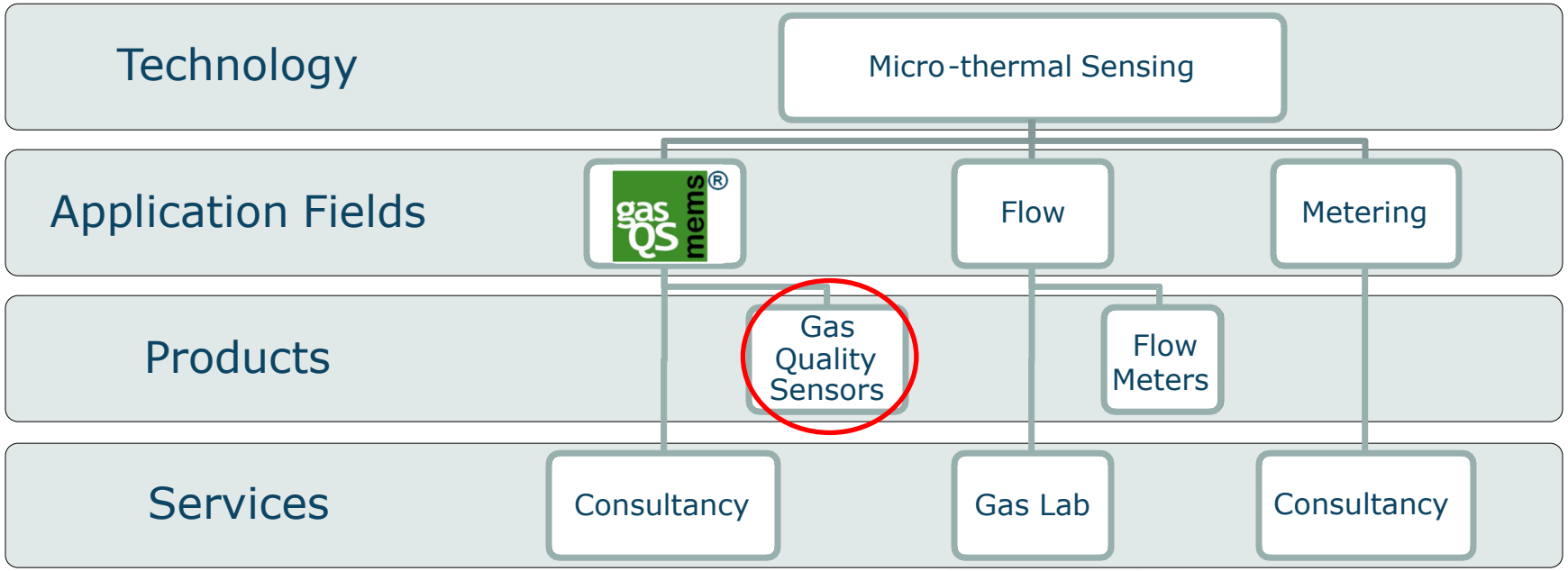
MEMS AG, 5413 Birmenstorf, Switzerland

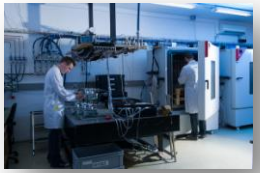
- **M**atter **E**ngineering for **M**etering **S**ystems alias
- **M**icro **E**lectro-**M**echanical **S**ystems

- since 2003
- Employees: 16
- www.mems.ch

- Gas measuring technologies
- Electronics developments

MEMS AG: Gas Measuring Technologies





Gas quality, a growing concern for end users?

- Why gas quality sensors for the gas industry?

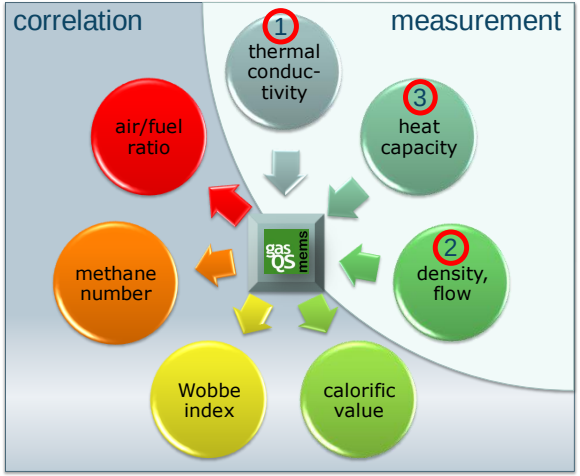
Available sensor technologies

Technology	Measured quantity	Pros +	Cons -	Costs	Main-tenance	Size	Robust-ness
Gas Chroma-tographs	gas composition	high accuracy	not for all gas types	high	high	large	low
Calorimeters	Wobbe, calorific value	direct measure-ment, no limitation on gas quality	only Wobbe, calorific value	high	high	large	low
Optical	gas composition	high selectivity	limited gas range	high	medium	medium	low
Correlative methods	physical sum parameters	response time	reduced accuracy	high	low	medium	medium
No devices available yet!				low	low	small	high

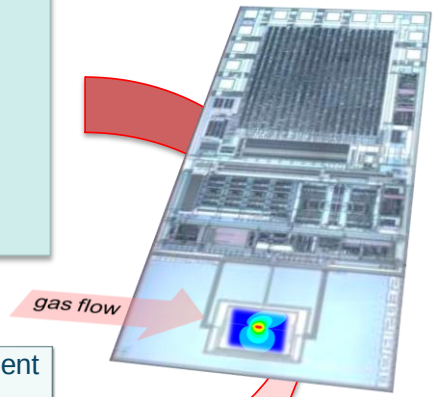
Micro-thermal chip sensing technology

CMOS chip technology

- fully integrated hot-wire anemometer
- standard industrial production process
- potentially cheap



3.5 x 2.1 mm²



10 x 6 x 6 cm³

gas QS mems®

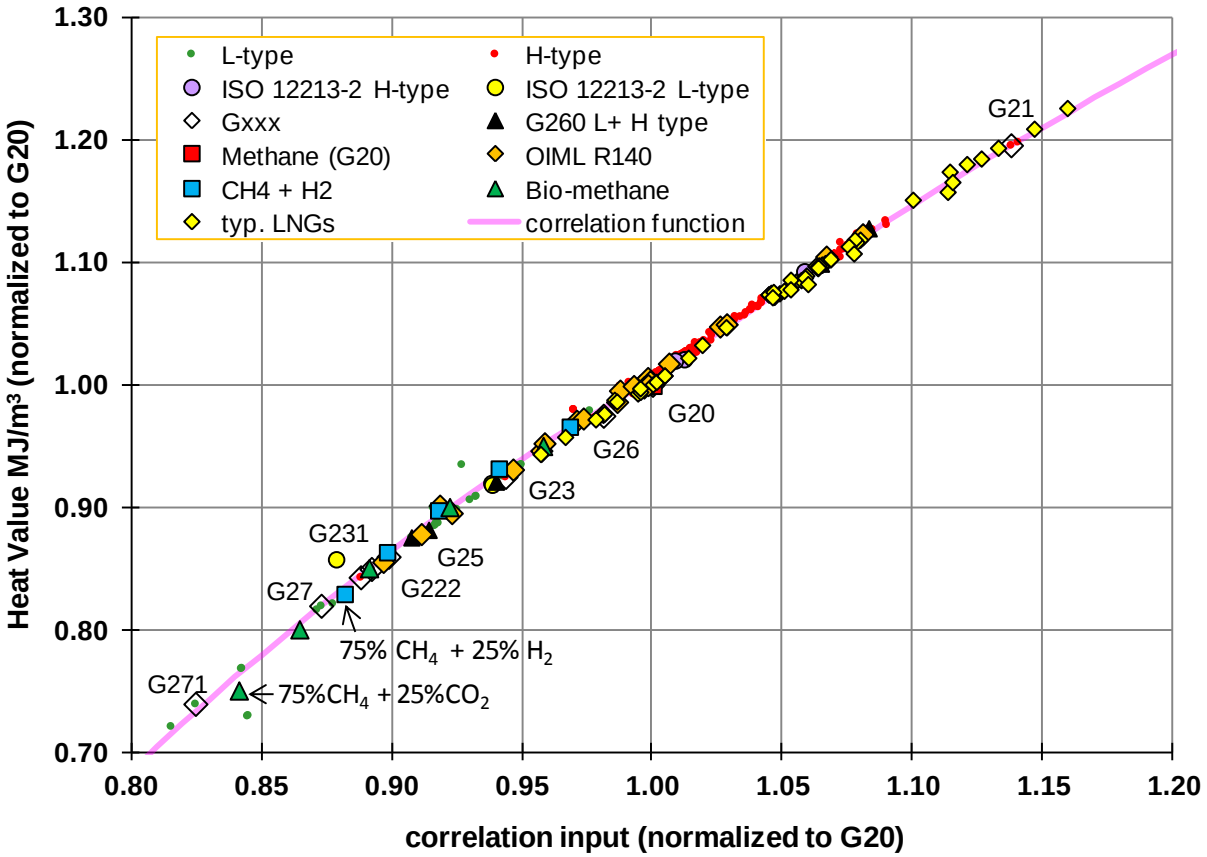
Gas quality sensing

- correlative measurement method
- IP owned by MEMS AG
- Technology registered as gasQS®

Advantages

- fast response
- compact size
- robustness
- low maintenace
- no re-calibration
- no reference gas
- ease of integration into a control system

Correlation example: heat value



Performance

- for the full gas range shown on previous slide

Gas quality	Accuracy	Stability
Calorific value	2 % rel.	0.2% rel.
Methane number	+/- 3 abs	+/- 2 abs
Wobbe index	2 % rel.	0.2% rel.
Density	2 % rel.	0.2% rel.
Gas temperature	+/- 0.5 K	+/- 0.1 K
Thermal conduct.	1 % rel.	0.3 % rel.

- higher accuracy for selected gas types, e.g. LNGs

Correlative measurement methods

EMC500:
> 20‘000 $

Source: RMG Honeywell

Correlative Measurement Principle		
Input 1	**Input 2**	**Input 3**
dielectric const.	c_{sound}	CO_2 content
c_{sound} (p_1)	c_{sound} (p_2)	CO_2 content
κ (T_1)	κ (T_2)	c_{sound}
κ	c_p	η
κ	IR absorption (non-dispersive)	
κ	IR absorption (λ_1)	IR absorption (λ_2)
gasQS		
κ	sonic nozzle	CMOS sensor

Gas Lab Q1:
> 20‘000 $

Source: Elster

< 2‘000 $ → „mass“ market

Available sensor technologies

Technology	Measured quantity	Pros +	Cons -	Costs	Main-tenance	Size	Robust-ness
Gas Chroma-tographs	gas composition	high accuracy	not for all gas types	high	high	large	low
Calorimeters	Wobbe, calorific value	direct measure-ment, no limitation on gas quality	only Wobbe, calorific value	high	high	large	low
Optical	gas composition	high selectivity	limited gas range	high	medium	medium	low
Correlative methods	physical sum parameters	response time	reduced accuracy	high	low	medium	medium
Now available!				low	low	small	high

competitive positioning of the gasQS technology

OEM sensor version

- Samples available @ MEMS
- compact (100 x 60 x 62 mm3)
- for field tests
- ease of operation
- support by MEMS
- service package: 25 k€

Application matrix

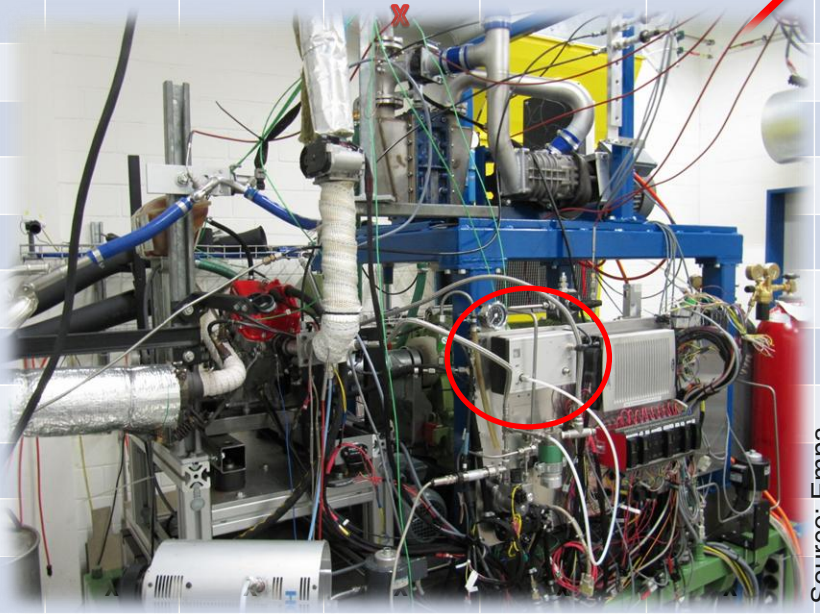
	Heat Value	Wobbe Index	Air/Fuel Ratio	Methane Number	Physical Properties	Binary Mixtures	Custo-mized	Flow
Research	x	x	x	x	x	x	X	x
Natural Gas Vehicles NGV								
• CNG	x			X				
• LNG	X			x				
Co-Generation	x		x	x				
Fuel Cells			X					X
Combustion								
• Boilers		x						
• Burners	x		x					
Bio Gas Plants	X					CO_2/CH_4		
Power-2-Gas						H_2/CH_4		
Gas Distribution Networks	X							
Instrumentation	X	x	x	x	x	x	x	x
OEM Products	x	x	x	x	x	x	x	x

x usually asked for in this application

X implemented / tested by MEMS

Application matrix

	Heat Value	Wobbe Index	Air/Fuel Ratio	Methane Number	Physical Properties	Binary Mixtures	Custo-mized	Flow
Research	x	x	x	x	x	x	✘	x
Natural Gas Vehicles NGV								
• CNG	x			✘				
• LNG	✘							
Co-Generation	x							
Fuel Cells								✘
Combustion								
• Boilers								
• Burners	x							
Bio Gas Plants	✘							
Power-2-Gas								
Gas Distribution Networks	✘							
Instrumentation	✘	x	x	x	x	x	x	x
OEM Products	x	x	x	x	x	x	x	x



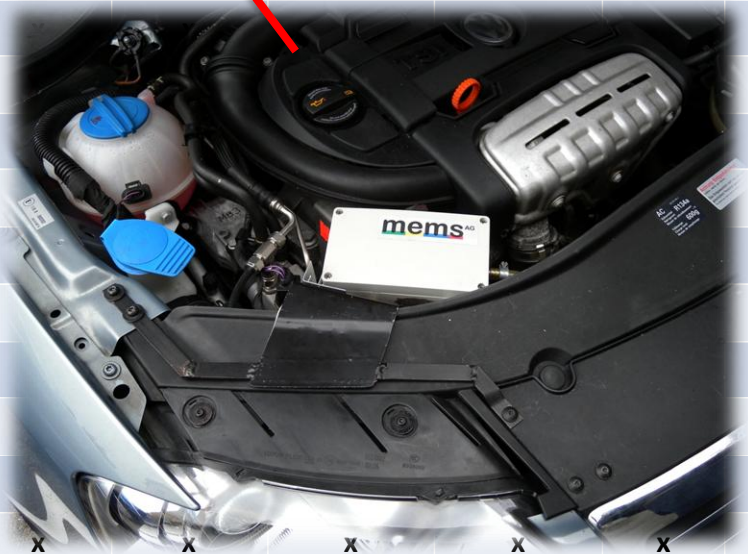
Source: Empa

x usually asked for in this application

✘ implemented / tested by MEMS

Application matrix

	Heat Value	Wobbe Index	Air/Fuel Ratio	Methane Number	Physical Properties	Binary Mixtures	Custo-mized	Flow
Research	x	x	x	x	x	x	✘	x
Natural Gas Vehicles NGV								
• CNG	x			✘				
• LNG	✘			x				
Co-Generation	x							
Fuel Cells								✘
Combustion								
• Boilers		x						
• Burners	x							
Bio Gas Plants	✘							
Power-2-Gas								
Gas Distribution Networks	✘							
Instrumentation	✘	x						x
OEM Products	x	x	x	x	x	x	x	x

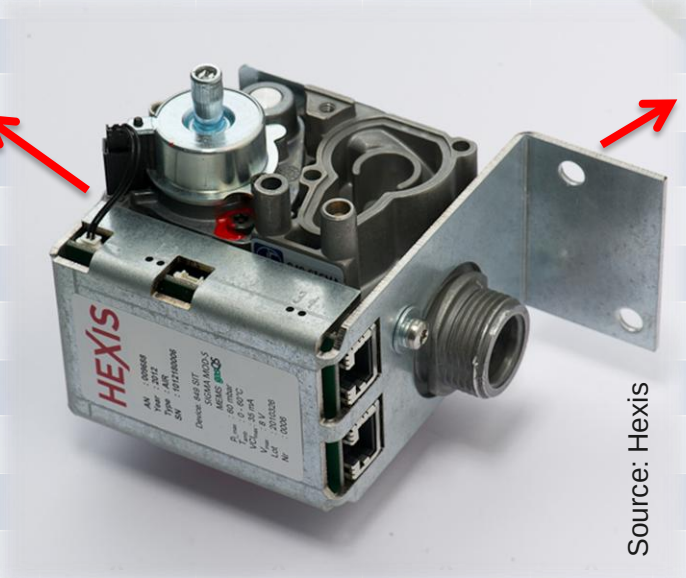


x usually asked for in this application

✘ implemented / tested by MEMS

Application matrix

gas QS mems ® mems AG	Heat Value	Wobbe Index	Air/Fuel Ratio	Methane Number	Physical Properties	Binary Mixtures	Custo-mized	Flow
Research	x	x	x	x	x	x	✗	x
Natural Gas Vehicles NGV								
• CNG	x			✗				
• LNG	✗			x				
Co-Generation	x		x					
Fuel Cells			✗					✗
Combustion								
• Boilers		x						
• Burners	x		x					
Bio Gas Plants	✗							
Power-2-Gas								
Gas Distribution Networks	✗							
Instrumentation	✗	x	x					x
OEM Products	x	x	x					x



Source: Hexis

x usually asked for in this application

✗ implemented / tested by MEMS

Application matrix

	Heat Value	Wobbe Index	Air/Fuel	Methane	Physical Properties	Binary Mixtures	Custo-mized	Flow
Research	x	x			x	x	✗	x
Natural Gas Vehicles NGV								
• CNG	x							
• LNG	✗							
Co-Generation	x							
Fuel Cells								✗
Combustion								
• Boilers		x						
• Burners	x							
Bio Gas Plants	✗					CO_2/CH_4		
Power-2-Gas						H_2/CH_4		
Gas Distribution Networks	✗							
Instrumentation	✗	x	x	x	x	x	x	x
OEM Products	x	x	x	x	x	x	x	x

x usually asked for in this application

✗ implemented / tested by MEMS

Application matrix

gas QS mems ® mems AG	Heat Value	Wobbe Index	Air/Fuel Ratio	Methane Number	Physical Properties	Binary Mixtures	Custo-mized	Flow
Research	x	x	x	x	x	x	X	x
Natural Gas Vehicles NGV								
• CNG	x							
• LNG	X							
Co-Generation	x							
Fuel Cells								X
Combustion								
• Boilers		x						
• Burners	x							
Bio Gas Plants	X							
Power-2-Gas								
Gas Distribution Networks	X							
Instrumentation	X	x	x	x	x	x	x	x
OEM Products	x	x	x	x	x	x	x	x

x usually asked for in this application

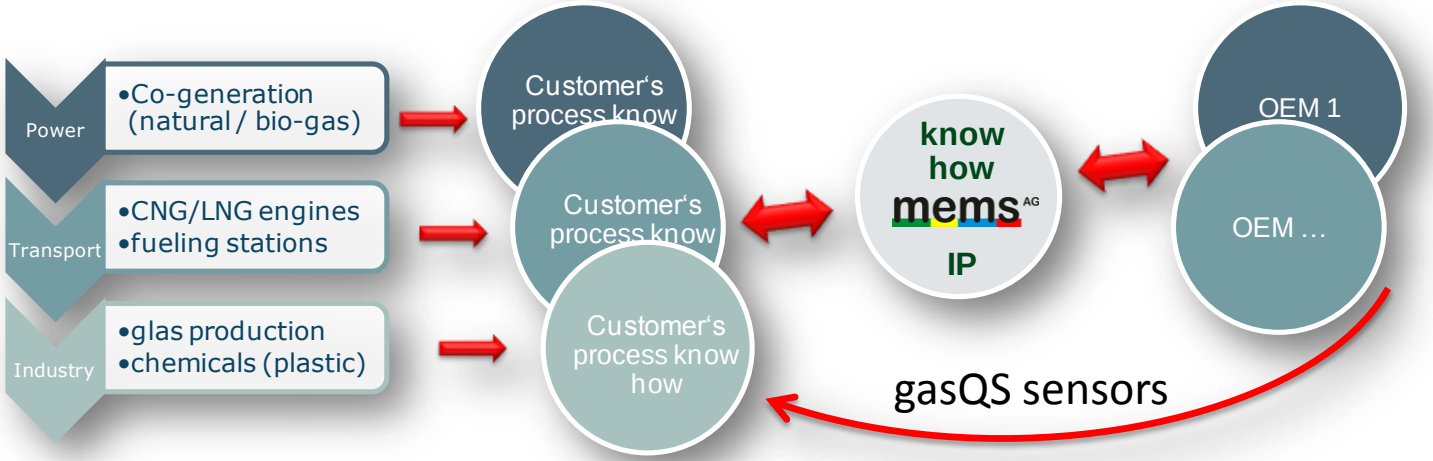
X implemented / tested by MEMS

Market penetration

Enabling
application specific field tests

Sharing
customer specific sensor versions

Licensing
OEM producers



Contact

- Come and visit us at booth K58!

For further information, please contact
philippe.pretre@mems.ch
+41 56 470 92 02