MEMS-Real: MEMS Reliability Assessment

Activity Summary

November 2014

1. The consortium

This project is carried out within the HTA consortium. The four partners CEA LETI, CSEM, Fraunhofer ENAS and VTT are part of the Heterogeneous Technology Alliance HTA which has been created in 2006 in order to join their forces in developments devoted to Microtechnology . A previous ESA project which has been carried out in its first phase between CSEM, Fraunhofer ENAS and CEA-LETI was WALES (RFQ 3-12437/08/NL/NA, Nov. 2009 – March 2013). In the currently running add-on project WALES-Plus (RFQ 3-13714/12/NL/PA) VTT joints the team. Another important ESA project related to MEMS reliability aspects is the project MEMS Qualification (RFQ 3-13681/12/NL/PA) which runs currently within a consortium of Lusospace (Portugal) and HTA.

CEA-LETI		CSEM		Fraunhofer ENAS		VTT	
Testing equipment	**Goal**	**Testing equipment**	**Goal**	**Testing equipment**	**Goal**	**Testing equipment**	**Goal**
Vacuum prober	- Electrical performances - Measurement on a specific environment (T°C, pressure)	Vacuum prober	- Electrical performances - Measurement on a specific environment (T°C, pressure)	Vacuum prober	- Electrical performances - Measurement on a specific environment (T°C, pressure)	Vacuum prober	- Electrical performances - Measurement on a specific environment (T°C, pressure)
Laser vibrometer	- Optical measurement of the Q factor - MEMS motion behavior	X-Ray phase contrast and X-ray tomography	- Non destructive inspection	X-Ray phase contrast and X-ray tomography	- Non destructive inspection	Cryo Chamber	- Resistance ot cryo temperature
RGA	- Composition measurement of package cavity	ESEM	-Micrometer range inspection - Surface composition analysis - Specific environment analysis (T°C, presure)	ESEM	-Micrometer range inspection - Surface composition analysis - Specific environment analysis (T°C, presure)	Optical profilometer	- Inspection - Optical measurement of the Q factor - MEMS motion behavior
Nanoindentation	- Hardness - Elastic modulus	TEM	-Sub micrometer range inspection	Shaker	- Mechanical resistance	Shaker	- Mechanical resistance
		HRXRD	- Stress - Strain	Mechanical shock	- Mechanical resistance	Mechanical shock	- Mechanical resistance
Environmental chamber	- Aging - MEMS behaviour on specific environment	Environmental chamber	- Aging - MEMS behaviour on specific environment	Environmental chamber	- Aging - MEMS behaviour on specific environment	Environmental chamber	- Aging - MEMS behaviour on specific environment
		AFM	- Surface roughness	Thermal shock	- Aging	Corrosion testing chamber	- Corrosion resistance evaluation
		Optical profilometer	- Inspection - Optical measurement of the Q factor - MEMS motion behavior	Scanning accoustic microscopy	- Non destructive inspection	Scanning accoustic microscopy	- Non destructive inspection
		Pull test	- Interface resistance evaluation	He leak test	- Evaluation of small leak rate	Gross leak test	- Evaluation of large leak rate

Table 1 List of equipment for each partner of the consortium.

Each partner has a large background of activities on MEMS reliability testing and their principal testing equipments are described in Table 1.

The project leading is ensured by O. Sereda from CSEM.

2. Overview of the activity

Since 90's, the MEMS market is presenting a high grow due to its high performances, low scale and low price. Originally driven by automotive market (air bag accelerometer and tire pressure sensor), it is now massively used in smartphone (image stabilization and automatic screen rotation), display (video projector) and entertainment (Wii motion sensor). In the next decade, MEMS devices will be found in any system from oil prospection to medical systems.

In opposition, only a few MEMS components have been or are planned to be used in space applications. Despites the growing interest for this new technology for space and the great reliability figures shows by earth-based sensors for application, specific space MEMS components have a low TRL. One important reason for this low TRL is the lack of possibility to assess the reliability of MEMS component in a standardized fashion and the lack of appropriate standards for qualification of MEMS components on which the industry could base themselves for future development and space us-age.

The objective of the MEMS-real project is to develop a standardization methodology and Technical Memorandum (TM) for the reliability assessment of MEMS products using commercial or ESA developed MEMS components.

A secondary objective is to identify suitable MEMS components for their use in space application through an experimental reliability assessment performed on those components. The idea is to have the same entity performing the same test plan on different components in order to have a direct comparison of their reliability and of the value of the drafted methodology.

To achieve the objectives, the work structure of this activity will be split into 4 technical tasks.

Task 1: Selection of MEMS suppliers

Task 2: Definition of the reliability testing methodology that will apply for testing the selected MEMS components.

Task 3: Procurement of the MEMS components and testing of the selected MEMS components. Preparation of detailed test reports and conclusion for each MEMS component including a comparison of the selected components and recommendations with respect to their suitability for space application.

Task 4: Preparation of a draft Technical Memorandum on MEMS reliability for ECSS consideration.