Towards a Design for Micro & Nano Manufacture Approach

2006-03-15

Patric Salomon
4M2C PATRIC SALOMON GmbH

Berlin
GERMANY
info@patent-dfmm.org
Tel: +49 30 24357870
www.patent-dfmm.org

Mid term results from the FP6-IST Network of Excellence "Design for Micro & Nano Manufacture (PATENT-DfMM)"

"Manufacturing starts with design". This statement holds especially true in the case of micro and nanosystem technology (MNT) enabled devices and systems as there are a range of manufacturing related difficulties that can be simplified by either design enhancements or the integration of additional functions. This design for micro & nano manufacture (DfMM) methodology is however immature and is one of the main reasons why the commercialisation of MNT based products is still severely limited despite a range of impressive research programmes, design innovations and initiatives across Europe.

Some of the key problems that affect manufacturability are now widely acknowledged and include difficulties in developing economic production test strategies and efficient packaging and assembly solutions. Guaranteeing robustness and reliability is also extremely difficult due to complexity and the heterogeneous nature of most MNT based products. Improved design support is also becoming a key commercial requirement with pressure on tool vendors to optimise models aimed at providing the designer with the means to predict the impact of second-order effects on the design (e.g. package induced stress and mode coupling), and verify end-use stability and subsequent reliability, especially in aggressive environments.

The need to solve these issues in MNT is hampered by the shortage of multidisciplinary, skilled engineers, and the need for major advances in simulation and modelling technology that handles hierarchical heterogeneous designs. Furthermore, many typical applications of micro & nano system technologies require very high reliability, and suitable test methodologies, standards and instrumentation are often missing. Time-to-market targets for most MNT products will therefore only be achieved if these so called "back-end" issues are addressed early in the design cycle.

Objective
The NoE Patent-DfMM aims to establish a collaborative team to provide European industry with support in the field of "Design for Micro and Nano Manufacture (DfMM)" to ensure that problems affecting the manufacture and reliability of products based on MNT can be addressed before prototype and pre-production.
The mission of the network is:
• Re-structure the European DfMM Community by creating new collaborative virtual laboratories providing industrial services in
o Design-for-test engineering
o Reliability and characterisation engineering
o Packaging engineering
o Modelling and simulation technology
• Create a commercial industrial support service in DfMM technology
• Accelerate the output of trained professionals in DfMM engineering
• Network key equipment facilities and improve academic and commercial access to core capabilities

Results to Date
As of January 2006, over 60 activities have been launched under the project framework to improve integration, generate new collaborative intellectual property through joint research, secure commercialisation routes for key services and establish the team as a key international cluster. Activities in the first 18 months mainly targeted improved integration within the 4 Virtual Laboratories, the second 18 months have however seen more cross-laboratory activities and 2006 will focus on testing the market for services and the launch of 3 key flagship projects.

• In the area of Test Integration, a 4 institute cluster has been established with skills in motionless testing of moving structures such as inertial sensors. New techniques have been developed based on bias modulation and a proof of concept demonstrated fabricated (fig. 1). A bio-sensor test cluster has also been developed with novel techniques published collaboratively. Work is now targeting drug discovery platforms based on a droplet transport technique (Fig. 2). In this area work is now merging with modelling activities that over the past 18 months has been focusing on fault and fault free modelling of droplet transport technology.
• In addition to the above, modelling and simulation work that focuses on design for manufacturing has been closely tied into the packaging activity. Studies have looked into Electro-magnetic coupling into MEMS structures, modelling of damping mechanisms / package environment in moving MEMS structures and enhanced stiction modelling in switches. A program of test structure fabrication and characterisation is also active to characterise new parameterisable behavioural models for better prediction of prototype behaviour and fault effects. A major study involves both modelling and test structure characterisation; this aims to fully understand and capture the impact of the most important package structures and adhesives on encapsulated MEMS devices.
• Database development has been active across the test, reliability and packaging domains. Initial content has been generated that covers material properties, failure mechanisms, instrumentation availability and packaging solutions. New test structures are currently under development and the characterisation work above will generate further data for this database. Initial plans to make this database commercially available do not appear feasible from an initial market study as revenue would be unlikely to cover the cost of maintenance. This database will hence form an internal resource for the NoE to support consultancy with industrial customers.
• Training development has secured core IPR that forms key material for tutorials, CPD courses and for a future Master's degree. Tutorials in thermal engineering and failure analysis have been delivered and been well accepted. The first 3 day course in Package Modelling & Analysis was delivered at IEF in December and the Distance Learning course in Modelling Technology to support MEMS manufacture is almost complete. There are a number of additional modules under development including test engineering and an interdisciplinary course that pulls together technology, management and societal issues. Two summer schools have been successfully run each attracting between 30 and 40 delegates.
• Interfacing the NoE to the commercial environment has received much attention. A portfolio of skills, services and exploitable IPR has been developed and a market test process initiated. A number of potential business models have been assessed for future delivery of the team's knowledge and resource to the industrial community. The NoE has taken leadership of the Reliability and Test MWG within NEXUS and 3 of the 5 new steering committee members of NEXUS are from the PATENT-DfMM NoE. This guarantees a strong pull from the NEXUS association for industrial access to PATENT-DfMM resources and optimal promotion of these resources.

Plans for 2006 / 2007
Within the first two years of the project, multi-disciplinary distributed teams have been established who are willing to deliver services to industry in collaboration. Critical mass in each of the 4 key disciplines has been established with numerous activities crossing the conventional discipline boundaries. An initial portfolio of services, skills and IPR has been compiled. 2006 will see the team putting most resource into 3 flagship projects that include 1. Design for Manufacture of Integrated Bio-MEMS platforms, HUMS integration into MNT-enabled technology and 3. Reliability Engineering that embraces clusters in acceleration factors, package reliability and harsh environments. These projects will focus the NoE resources and skills into activities that will generate case studies to demonstrate competence and capability within the technical clusters offering industrial services. Further focus will be established through testing the market for DfMM services.

More information:
www.patent-dfmm.org
E-Mail: info@patent-dfmm.org

Subject: Electronics Microelectronics; Industrial manufacture; Information Society Technology; Nanotechnology; Sixth Framework Programme; Standards Measurements; Technology; Seventh Framework Programme;
Country: AUSTRIA; BELGIUM; CZECH REPUBLIC; GERMANY; DENMARK; ESTONIA; SPAIN; FINLAND; FRANCE; UNITED KINGDOM; GREECE; HUNGARY; IRELAND; ITALY; LITHUANIA; LUXEMBOURG; LATVIA; MALTA; NETHERLANDS; POLAND; PORTUGAL; SWEDEN; SLOVENIA; SLOVAKIA;
Institution: Small Company;
Category: Project;
Programme Acronym: ISTC;

RCN: 6545