NANOTHERM

Innovative Nano and Micro Technologies for Advanced Thermo and Mechanical Interfaces

December 2014 Newsletter #2

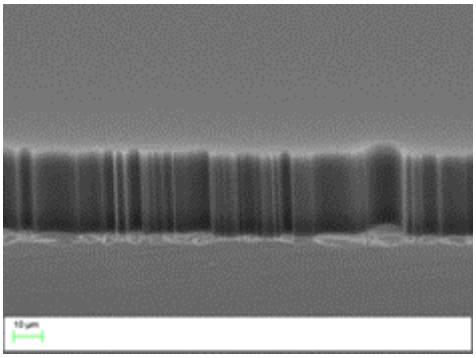
NANOTHERM is a European large-scale integrating project aiming at the development, integration and manufacturability of advanced interface technologies for superior thermal and thermo-mechanical design for heterogeneously integrated power systems on different technology platforms for different market segments in industry.

In second year of the project, the accent was put on the development and characterization of materials and on the optimization of interface processing.

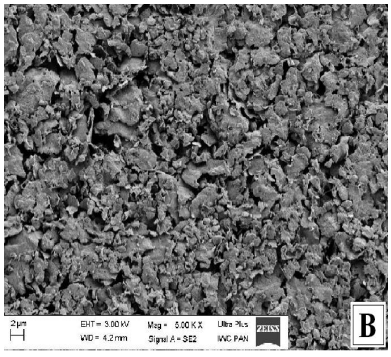
Main developed technologies and processes

The project consortium focused on the development and bulk material characterization of new enhanced nano-scaled, micro-scaled and mixtures of nano-scaled and micro-scaled materials for TIM and die attach, as well as to the design of the substrate material, needed to fulfill the demonstrators specifications. The following material technologies were selected:

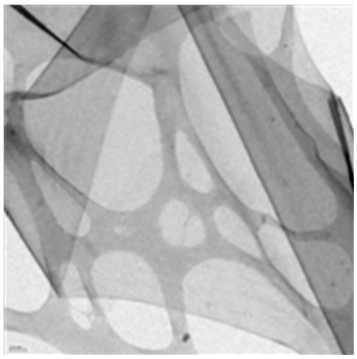
- Vertically aligned carbon nanotubes (VACNT)
- n-Ag Sinter inks
- µ-Ag Sinter pastes
- µ-Ag Sinter adhesives
- Ag-coated SiC adhesives
- Graphene based adhesive or coating



VACNT



Silver micro flakes

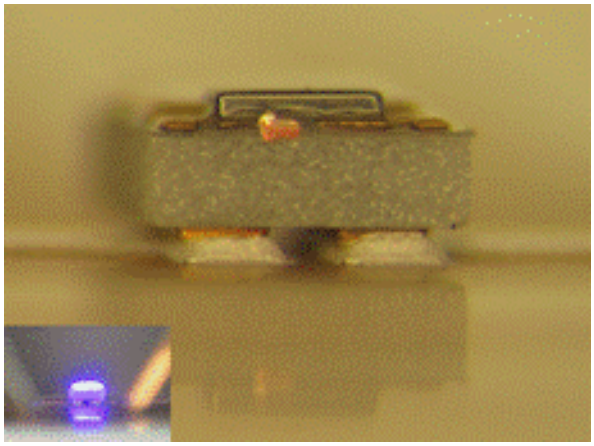


Graphene

Selected progress in demonstrators

Lighting demo

The energy efficient Lumens per Watt performance of high power LEDs is outperforming alternative technologies in outdoor, industrial, hospitality, architectural and automotive lighting areas. Demands for lower cost drive the need for smaller high power LEDs with more light output resulting in higher power densities and higher heat flux densities. Currently, the thermal performance of LED devices is a strong limiting factor in achieving optimal performance. The goal of the Philips lighting demonstrator is to improve performance under high operating temperatures and high power densities. This will be accomplished by means of a combination of novel substrate technologies and next-generation thermal interface material for ceramic or leadframe components. The activities to achieve this goal concentrate on making sinter silver technologies available for component attach applications.

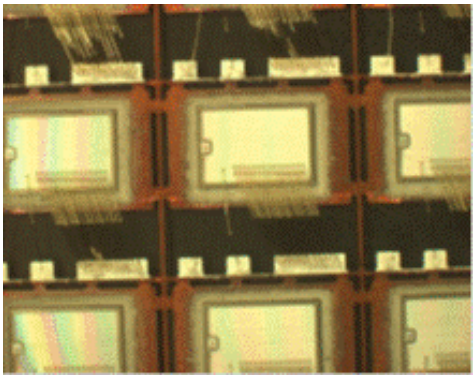


Luxeon-Z on IMS with Sinter Silver Adhesive.

Process and material optimization resulted in first lab-built functional demonstrators. The demonstrator shows a ceramic Philips Luxeon-Z LED package mounted on an insulated metal substrate (IMS) using sinter silver technology.

Multimarket demonstrator

Reduction of the die size and increase of operating temperature are essential requirements for future of power semiconductors especially in the multi market application. Die-attach for power semiconductors is a strong limitation factor in achieving high thermal conductivity and high operating temperatures enabling reduction of the die size. The chip size reduction leads to strong increase of power densities and therefore to increasing requirements for die-attach material.



Pre-Demonstrator with sintering technology

Different process variants were investigated. Especially the influence of sintering temperature, time and pressure on the mechanical properties of sintered material was investigated

Based on the results achieved for the pre-investigations, first test vehicle were fabricated with a special coating method of leadframes, stencil printing and sintering of a silver paste

Electrical measurements showed full electrically functionality of the packages.

Reliability demonstrator

The Viking Reliability Testing (VRT) framework has been designed to meet the foreseen testing requirements of the TIM1 and TIM2 solutions developed by the project partners and applied in the demonstrators of the NANOTHERM project. The VRT system is based around commercially available test equipment and test environments. The glue hardware and the software interface of the VRT system has been designed to meet the specific needs of the project.

The prototype of the operating software was realized in LabView prior to the availability of the final hardware. With the software prototype VRT is ready to be used for testing the other project demonstrators (work on the lighting demonstrator has already started). The embedded version of the operating software (providing full, PC-independent, robust automation of setting and controlling the stress conditions and performing the necessary measurements during aging) is being finalized by now.

Photo of the Viking Reliability Tester (VRT) with the measurement setup used for pre-stress LED evaluation

Special sessions at conferences

A poster and exhibition booth was setup at EUROSIME, IEEE International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems, Ghent, Belgium, on April 7-9th 2014

A special NANOTHERM session was held during the 20th International Workshop on Thermal Investigations of ICs and Systems, THERMINIC, in in London, Greenwich, UK on 26th September 2014. 6 scientific papers related to NANOTHERM subjects were presented and discussed by project partners and external speakers. This session was a very good opportunity to discuss and compare the different approaches, and will serve to gain new ideas to achieve the goals of the NANOTHERM project.

SEVENTH FRAMEWORK PROGRAMME

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