

**COURSE TITLE:** Harsh Environment Packaging using Polymers

**INSTRUCTORS:** Karl-Friedrich Becker, Tanja Braun, Jörg Bauer, Hans Walter, Fraunhofer IZM

**Objectives of this Course:**

Harsh environment applications – in automotive, avionic, industrial and sometimes also in the medical field – demand a robust packaging technology. To meet the challenging cost targets the use of polymer materials for packaging, and especially encapsulation, is essential. Within this tutorial, the possibilities of polymer encapsulation for harsh environment are discussed ranging from media resistance of the various packaging materials to the process options available for robust packaging to material analysis investigating not only initial state, but also the degradation processes occurring during device use. Also package reliability issues are discussed – giving an overview on the status of polymer based packaging for e.g. Flip Chips, molded packages and more advanced packages as embedded components.

**Course Outline / What You Will Learn:**

1. Polymer Material Fundamentals – Material Classes - Reaction, Rheology & Degradation
2. Materials for Harsh Environment Encapsulation - Optimized Selection
3. Material and Package Analysis for HiTemp and Harsh Environment Use

**WHO SHOULD ATTEND:**

Engineers, scientists and managers involved in the design, process and manufacturing of microelectronic systems intended to be used in harsh environment.

**ABOUT THE INSTRUCTORS:**

**Karl F. Becker** studied materials science at Technical University of Berlin. Focus of his studies was polymer physics with Professor Hinrichsen. Since 1996 he is with the Fraunhofer IZM as a member of the group Encapsulation Technologies, since 2001 he is heading the group. His field of research is process development of encapsulation processes, the qualification of these processes using both nondestructive and destructive tools and polymer encapsulant analysis using thermal / thermo-mechanical and rheological analysis methods, as well as assembly processes for multisensor modules / SiPs. Recent research is focused on the use of encapsulants/package materials with added functionality using nanoscale building blocks. He is member of IMAPS and IEEE. For his work he received the Fraunhofer IZM research award in 2007.

**Tanja Braun** studied mechanical engineering at Technical University of Berlin with a focus on polymers and micro systems and joined Fraunhofer IZM in 1999. Since 2000 she is working with the group Assembly & Encapsulation Technologies. Her field of research is process development of assembly and encapsulation processes, the qualification of these processes using both nondestructive and destructive tools and polymer encapsulant analysis using thermal / thermo-mechanical / rheological analysis methods. Recent research is focused on reliable sensor packaging for automotive and biomedical application as well as the modification and use of encapsulants/package materials with enhanced nano-fillers for high reliable packaging. Results of her research concerning packaging for advanced packages have been presented at multiple international conferences. Tanja Braun is Member of IEEE.

**Jörg Bauer** studied mathematics and physics at Humboldt University of Berlin. He received a doctor's degree in polymer science in 1984. Since 1992 he is with the Fraunhofer society as a member of groups dealing with development and application of polymers especially thermosets. His field of research is characterization of polymers and polymer networks, high-performance polymers for encapsulation materials, structure-property relationships of polymers, nanostructure enhanced polymers.

**Hans Walter** received his Diploma Degree in Mechanical Science from Martin-Luther-University, Halle-Wittenberg, Germany, in 1995. From 1995 to 1999, he was a staff member of the Department of Engineering Science at Martin-Luther-University. In 1995, he also joined the Fraunhofer Institute for Reliability and Microintegration (IZM), Berlin, who is still a member of today. He received his Ph.D. in Materials Science from the Martin-Luther-University, Halle-Wittenberg, in 2003. Since 2000, he has been co-working with the Angewandte Micro Messtechnik GmbH (AMIC), Germany. At Fraunhofer IZM, he is currently involved with thermo-mechanical characterisation and experimental determination of fracture behaviour of materials and components. He is head of the Fraunhofer  $\mu$ -Materials Testing Lab. He has published several papers in the fields of micro-materials measurement techniques, fracture behaviour and thermo-mechanical analysis from materials of electronic applications.