Kossi Nicolas Assigbe et al., Polym Sci, 3:3
DOI: 10.4172/2471-9935-C1-002

Thermo-mechanical characterizations of polymers for microelectronics applications

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In microelectronics, 3D integration involves stacking different electronic components on a substrate. During the various steps of the process, bonding is carried out using several types of polymeric materials. The use of these materials can be advantageous: they are generally carried out at deposition temperatures lower than those of the other integrated materials and it is possible to integrate them in liquid form under components and then crosslink them. They also have the advantage of offering various mechanical properties, which make it possible both to protect certain components but also to produce more flexible layers if necessary. Conversely, they exhibit high coefficients of thermal expansion (CTE), which can lead to problems of reliability of the components. Moreover, their mechanical properties can change over time when the crosslinking annealing has not been optimized. Thus, their characteristics may be unstable when used in manufacturing processes. The aim of this work is to develop a method for studying the evolution of thermomechanical properties of polymers used in manufacturing processes as a function of temperature. In the first part of this work we carried out experimental measurements using a measuring equipment (k-SA MOS Thermoscan) to measure the evolution of the curvature of deposit materials on substrate. We carried out this study for different types of polymer materials deposited on a silicon substrate. The objective is to measure their curvature evolution for different temperature. The equipment is equipped with an in-situ furnace which allows us to heat the plate with a controlled temperature ramp from ambient temperature up to 1000 ° C. In the second part we have developed an analytical calculation program to solve static equilibrium equations during cooling or heat treatment taking into account thermo-elastic properties variation. From the measurements of curvature variations, an inverse analysis makes it possible to identify the thermo elastic properties of the polymers films. Finite element validation will also be presented.

Biography

Kossi Nicolas ASSIGBE, I am a young researcher of 24 years born in TOGO with a diploma of mechanical design engineer (TOGO, 2014) and a master research in materials mechanics (France, 2015). Passionate about understanding the behavior of materials, I am now working on the temperature instability of the thermomechanical properties of polymer films used in microelectronics. I am a PhD student based at CEA (Commissariat of Atomic Energy and Alternative Energies) and SIMaP (Laboratory of Science and Engineering of Materials and Processes).

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