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Presentation title: LDS and AMP Processes for RF Antenna in Package (AiP) Applications in the E- and D-Bands

SHORT ABSTRACT OF PRESENTATION

The SHIFT project develops sustainable technologies for future telecom applications by seeding an innovative European ecosystem. This part of this ecosystem is dedicated to establishing new manufacturing chains of intelligent microelectronics packaging building on innovative active mold packaging (AMP) technology.

In the SHIFT project, S2P-Smart Plastic Products is positioned on the manufacturing of the advanced packaging of components using the AMP technology, for antenna-in package (AiP) and antenna-in-module (AiM) solutions. The use of AMP technology has several advantages, including: (i) integration of antennas and interconnections in small volume, (ii) innovative radio frequency (RF) concepts, and (iii) carbon footprint reduction using recyclable packaging materials, and reduction of precious metals.

The AMP process is based on three main steps:

- the molding of thermoplastics or thermo-set epoxy mold compound;
- the laser activation to structure the artwork directly from the computer onto the plastic component;
- the chemical electroless plating to create the track.

The KMC9220 resin from Shin-Etsu was chosen due to its preliminary adoption by the packaging ecosystem. The material has been supplied as pellets and delivered to STMicroelectronics, Grenoble, France, which performed preliminary transfer molding trials. Using molded samples, we made first activation and metallization trials with a fiber 1064 nm

infrared pulsed laser (3D-Microline 160i), to build the design rules for electronics and antennas designers using this equipment. On the other hand, we also tested a UV laser at 355 nm (Picoline 3000 Ci), which enables tracks and interspaces of 25 μm and lower roughness to address high-frequency applications.

In parallel with the mentioned AMP tests, the electrical material characterization was achieved by the IEMN Laboratory, Lille, France, by providing them some LDS resin samples. The obtained results show that the dielectric constant DK and the dissipation factor DF are about 3.8–3.9 and 0.005–0.01, respectively, in the frequency range of 100–600 GHz.

The material characterization will be validated by designing, manufacturing, and measuring some RF functions such as 50 Ω microstrip line and coplanar waveguide, before proceeding to the targeted AiP demonstrators in the project.

KEYWORDS

Antenna-in-package, epoxy resins.

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BIOGRAPHY

Abdel Hadi Hobballah received the M.Sc. degree in applied physics and physical engineering, and the Ph.D. degree in antenna and RF circuit design from the University of Limoges, France, in 2019 and 2022, respectively. He is currently a project manager with S2P-Smart Plastic Products, France, where he applies his RF skills in the manufacturing of antennas using the laser direct structuring (LDS) process of the 3D-MID molded interconnect device technology.