Nanopackaging Technology Highlights at Recent ECTC and IEEE NANO 2020
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The primary mission of Nanopackaging TC is to promote nanotechnologies to packaging community and accelerate their adoption by disseminating the knowledge through conferences, webinars, industry-academia interactions, IEEE web portals, newsletters and other means. The final goal is to create synergistic research ecosystems to solve the technical barriers and enable future electronics. The recent conferences, IEEE NANO and ECTC brought several key advances in nanopackaging to limelight. This newsletter highlights those advances and also provides details about upcoming IEEE NMDC 2021 and upcoming IEEE International Electronics Week in Europe.

Nanopackaging advances can be seen at all levels: components, miniaturization and reliability but most importantly as the key enabler for future smart healthcare systems. From component standpoint, key advances reported in NANO2020 and ECTC 2020 continue to highlight the role of new materials such as graphene and carbon for sensing, electrodes for battery (University of Rome, Italy) and enzymatic biofuel cells for wearable electronics (BITS, India), metal nanoparticles for additively-deposited interconnects and bonding interfaces. For example, graphene-elastomer electrodes can be a compelling technology for low-impedance cuff electrode for neural recording to control prosthetics (Imperial College, London). They also serve as strain and pressure sensors because of their optimal combination of high conductivity and low modulus. Presentations at ECTC from FIU illustrate that nanomaterials with elastomeric properties play a key role on flex-to-textile interconnects, rigid-to-flex or flex-to-flex remateable interconnects with low electrical impedances and high mechanical reliability. Fine-pitch lines and spaces with low mm wave interconnect losses from aerosol jet printing (AJP) was shown by SUNY, Binghampton. In this work, low-temperature laser-assisted sintering is shown to achieve 30% of bulk conductivity on flex substrates, while also managing the roughness to control mm wave losses. Nanopackaging with high-power metal die-attach layers is also advancing by migrating away from expensive silver nanoparticles to cheaper copper or Cu/Ag nanoparticles. Further advances in stress reduction are envisaged by loading the die-attach nanopastes with low-CTE graphene particles or low-modulus foam architectures.

Top-down nanoscale systems with advanced processing was highlighted in ECTC, where 500 nm TSVs with sub-micron through-silicon layers of 70 nm through-thickness variation, was presented by IMEC. The key innovation is in the development of unique wafer-to-wafer bonding and via-last TSVs to enable such downscaling. Similarly, CNT-based vertical IC integration was demonstrated by NTU, Taiwan to address limitations of copper TSVs in terms of electrical and thermal conductivity and high stresses from mismatch in thermal expansion.

As new system enablers for emerging product segments, nanodevice integration with nanopackaging will bring key applications such as neuromorphic computing with 2D materials, self-sustained (energy harvesting) wearable systems for monitoring physiological signals as well as for autonomous human-machine interfaces (NUS, Singapore), portable point-of-need diagnostics by integration 3D photonic nanostructures with integrated fluidic delivery and biofunctionalization (McGill University, Canada) to enable early detection of diseases through their biomarkers. One such example is the detection of diabetes-induced abnormal chirality through plasmonic chiral sensing (UT Austin). Microrobotic swarms, with in vivo tracking, control and manipulation will play a key role in targeted drug delivery through ultrasound, magnetic, electric fields (City Univ of Hongkong, CUHK). An innovative approach of photothermal therapy with nanoplasmonic optical antennas is presented by CUHK. The benefits of nanopackaging is also evident in the integration of IoT and cloud-based biomedical sensor systems for clinical measurements through wearable health-monitoring systems. IEEE NANO 2020 covered several exciting sessions in these areas. Interested readers will find the upcoming IEEE NMDC 2021 equally exciting and valuable as highlighted next.

EPS and NTC welcomes you to the 16th IEEE Nanotechnology Materials and Devices Conference (IEEE NMDC 2021), which will be held in Vancouver, BC, Canada from October 17th to 20th, 2021. IEEE NMDC 2021 will be hosted at the Pinnacle Harbourfront Hotel located in the center of Vancouver. The conference will be co-located with the IEEE Conference on Electrical Insulation and Dielectric Phenomena (IEEE CEIDP).

IEEE NMDC is a well-received international conference sponsored by the IEEE Nanotechnology Council. It has been held annually rotating in different parts of the world; in 2019 it was in Stockholm, Sweden and is meeting Virtually (due to COVID-19 restrictions) in 2020. IEEE NMDC aims to highlight current work and future directions in nanotechnology-related research in the areas of nanomaterials and fabrication, nanoelectronics, packaging, nanophotonics, bioengineering, devices, and integration. This conference brings together key researchers from every sector of the nanotechnology research field, with a special focus on materials and devices. More information about the IEEE NMDC 2021 and Vancouver can be found on the conference web-site (https://ieeenmdc.org/nmdc-2021/). Readers are requested to contact Prof. James Spicer (John Hopkins Unversity, spicer@jhu.edu) for active involvement in this conference.

Welcome to the "International Electronics Week in Central and South-Eastern Europe): Between the 19th – 23rd of October 2020, a unique "International Electronics Week in Central and South-Eastern Europe" will be organized online. This live scientific event coalesces three main events held traditionally in Romania: TIE, TIEPlus (www.tie.ro), and SIITME (www.siitme.ro).
The TIEPlus contest on the 19th of October is the final stage in the industrial certification of the students' knowledge in signal and power integrity and virtual prototyping. The event is followed by a scientific workshop debating various topics, such as electrical, mechanical, and thermal issues of multi-layer chip capacitors.

Tuesday, the 20th of October, is dedicated to the TIE computer-aided design contest. In the afternoon, the evaluation teams (composed of academic and industrial members) evaluate the contestants' design results. The list of participants, who have met the conditions of a certified PCB designer, is established in the evening at the TIE committees' meeting.

On Wednesday, the 21st of October, several workshops will be held. In the morning, the first chapter of HIR (Executive summary) and the topic "Electronic Industry-Academy, Strategic Partnership" will be discussed, followed by a debate on "TIE and TIEPlus subject demystification" and the TIE/TIEPlus Awarding Ceremony. In the afternoon, an industrial panel discussion with the theme "Introduction to HIR Modeling goals" and a professional development course, "Signal and power integrity," will be held. The day ends with the annual IEEE-Hu & Ro EPS & NTC Joint Chapter Meeting.

On Thursday and Friday, 22nd and 23rd of October, the 26th International Symposium for Design and Technology in Electronic Packaging (SIITME) conference will deliver its dense program with oral sessions, industrial sessions (Bosch, Continental, Miele, Murata on the 22nd and Vitesco Technologies

and Wuerth Electronic on the 23rd), and poster sessions. On Friday, late afternoon, an IEEE and IMAPS Student Branch Chapter Kick-off Meeting will be also be held. Readers are requested to contact Prof. Attila Bonyar for more information about this conference (bonyar@ett.bme.hu).