

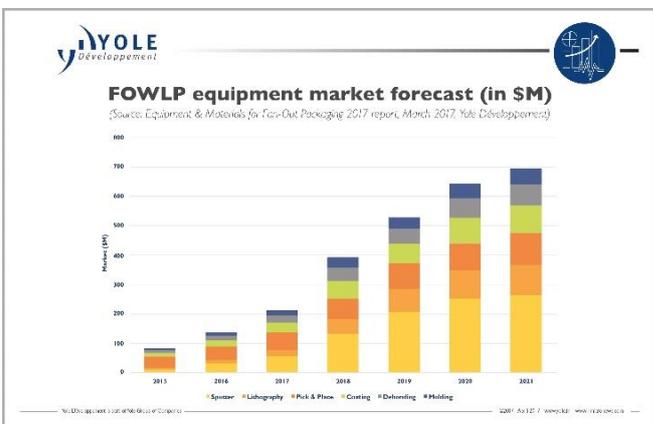
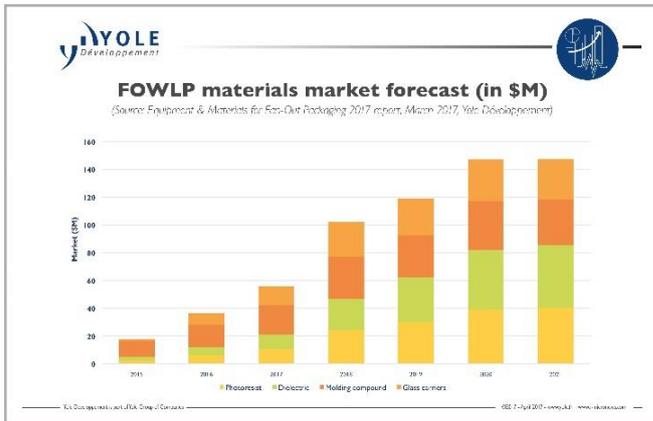


FOR IMMEDIATE RELEASE:

Equipment & materials for fan-out: What is the impact of most dynamic advanced packaging platform on manufacturing markets?

Equipment and Materials for Fan-Out Packaging 2017 report – Yole Développement – March 2017

LYON, France – April 6, 2017: 2016 was a turning point for fan-out packaging. With Apple’s entrance and its subsequent decision to package its A10 APE in TSMC’s fan-out solution¹, the market changed. Thus advanced packaging leaders decided large investments for the development of fan-out platforms, impacting the related equipment and materials market. *“Indeed, both equipment and materials markets for FOWLP² will reach an impressive 40% CAGR³”,* confirms **Jérôme Azémar, Technology & Market Analyst, Advanced Packaging & Semiconductor Manufacturing at [Yole Développement \(Yole\)](#).**



A detailed description of both markets and a list of equipment and materials studied by Yole is available in the new report [Equipment and Materials for Fan-Out Packaging](#). According to this technology & market analysis, the total FOWLP equipment market is expected to reach about US\$694 million in 2021 at an impressive CAGR of 42.5% between 2015 and 2021. Similarly, FOWLP’s total materials market is expected to reach about US\$148 million in 2021 at a CAGR of 40% during the same period.

How is Fan-Out success driving the equipment & materials market? What is the impact of the huge investments listed during the 2015-2016 period? Under this dynamic context, where are the business opportunities? Yole’s advanced packaging team is expecting lot of changes in the coming years and offers you today a snapshot of these industries.

¹ Source: [TSMC Integrated Fan-Out \(inFO\) Package in Apple’s A10 Application Processor reverse engineering & costing report](#), 2016, System Plus Consulting

² FOWLP : Fan-Out Wafer-Level-Package

³ CAGR : Compound Annual Growth Rate

In its report, the “More than Moore” market research and strategy consulting company proposes a clear picture of new investments and future markets for equipment and materials in Fan-Out. This report focuses on FOWLP’s key process steps, which Yole believes are most essential to the platform: carrier bonding/debonding, chip placement, molding and RDL⁴ processing.

The equipment studied in the report that enables the aforementioned process steps includes pick-and-place bonders, lithography tools, sputter tools, molding tools, carrier debonding tools, and coaters/developers. In parallel, key materials investigated in Yole’s report include RDL dielectrics and photoresist, molding compound, and glass carriers.

As mentioned, 2015 – 2016 period saw large investments in FOWLP. *“With the FOWLP adoption spreading from mobile/wireless and automotive to MEMS, RF SiP, and medical, a wealth of lucrative business opportunities exist for fan-out equipment and materials suppliers”*, details Jérôme Azémar.

2017 will not see the same investment level, but the potential for new moves is high. Capacity enlargement is still an option for players considering it; in fact it may be required in two years if fan-out keeps growing in high-density applications. Newcomers will gain some market share, necessitating entry into volume production. However, with 4.5 million wafers to be produced in 2021, capacity must also be increased by TSMC and/or other actors. Therefore, a second wave of investment must occur soon or capacity will not be sufficient to address the FOWLP market if it continues growing.

As a consequence, growth will be significant for all equipment and material types, indicating broad benefit from the FOWLP platform’s success. However the challenges and market landscapes are very different from process step and the market is quite diversified. For example, lithography for patterning RDL represents one of the largest market components thanks to the equipment’s high value and the large volume of photoresist. In lithography, a “stepper”-type litho tool is used for FOWLP RDL patterning in order to achieve low-resolution (down to 2µm today), but its cost is high and manufacturers are under strong pressure to reduce their prices. *“This market is currently dominated by Ultratech, which supplies TSMC, and Rudolph which has enjoyed success with OSATs”*, says **Santosh Kumar, Senior Technology & Market Research Analyst at Yole**. And he adds: *“We expect other players to penetrate this area, potentially with different approaches like laser ablation.”*

⁴ RDL : Multi-Layer Redistribution

Other steps, i.e. mold compound processing, may be more prone to domination by a single player. This symbolic step, which creates a reconstituted wafer out of a mold in which the IC are encapsulated, is almost entirely owned by Nagase Chemtex, almost 90% market share on the materials side. Nagase Chemtex's dominance is the result of the complex approach such chemicals require in order to develop an optimum solution, and the long history Nagase has with the main producers including Nanium and STATS ChipPAC. LMC⁵ is currently the preferred FOWLP mold material, however, to break Nagase's monopoly and reduce cost, other materials suppliers are working to develop GMC⁶. By 2021, GMC is expected to have 29% of the total market. On the equipment side, things are more diversified, with APIC, Yamada, and Towa the key compression molding-tool suppliers for FOWLP.

A detailed description of [Equipment and Materials for Fan-Out Packaging 2017 report](#) is available on i-micronews.com, advanced packaging reports section.

⁵ LMC : Liquid Molding Compound

⁶ GMC : Granular-type Molding materials



About [Equipment and Materials for Fan-Out Packaging 2017](#) report

What to expect from manufacturing's most dynamic advanced packaging platform?

▪ Authors:

Jérôme Azémar is a member of the Advanced Packaging & Manufacturing team at Yole Développement, the “More than Moore” market research and strategy consulting company. Upon graduating from INSA Toulouse with a master’s in Microelectronics and Applied Physics, he joined ASML and worked in Veldhoven for three years as an Application Support Engineer, specializing in immersion scanners. During this time he acquired photolithography skills which he then honed over a two-year stint as a Process Engineer at STMicroelectronics. While with STMicroelectronics, he developed new processes, co-authored an international publication, and worked on metrology structures embedded on reticles before joining Yole Développement in 2013.

Santosh Kumar is a Senior Technology & Market Research Analyst at Yole Développement, the “More than Moore” market research and strategy consulting company. Prior to joining Yole, Santosh worked as senior R&D Engineer at MK Electron Co. Ltd where he was engaged in electronic packaging materials development and technical marketing. His main interest areas are advanced electronic packaging materials and technology, including TSV and 3D packaging, modeling and simulation, reliability and materials characterization, wire bonding and novel solder materials, and process. He received a bachelor’s and master’s degree in Engineering from the Indian Institute of Technology (IIT) Roorkee and the University of Seoul, respectively. Santosh has published 20+ papers in peer-reviewed journals and obtained two patents. He has also presented and spoken at numerous conferences and technical symposiums related to advanced microelectronics packaging.

▪ Companies cited in the report:

3D-Plus, 3M, AGC, Amkor, Analog Devices, Akrometrix, Apple, Applied Materials, ASE, ASM, Besi, Boschmann, Brewer Science, Broadcom, Bosch, Camtek, Corning, Dialog Semiconductor, Dow, EVGroup, Fico Molding, Freescale (NXP), Fogale, Fujifilm, HD Microsystems, Henkel, Hi Silicon, Hitachi Chemicals, Hoya, Huawei, Ibsiden, IME, Infineon, Intel, JSR, Limtec, Mediatek, Medtronic, Mitsui Chemicals, Nagase ChemteX, Nanium, Nanometrics, Nepes, Nitto Denko, Nokia, NXP, Plan Optik AG, Oerlikon (Evatec), Platform Specialty Products, Qualcomm, Rudolph Technologies, Samsung, SEMCO, SEMPRIUS, Shinko Electric, SPIL, STATS ChipPAC (JCET), STMicroelectronics, Schott, Screen, SPTS Technologies (an Orbotech company), Shin-Etsu, Sumitomo, SUSS MicroTec AG, TEL-NEXX, TSMC, TOK, Toray Chemical, Towa, Unovis, Ultratech, ULVAC, Ushio, UTAC, Yamada, and more...



About Yole Développement – www.yole.fr

Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole Développement group has expanded to include more than 50 collaborators worldwide covering MEMS, Compound Semiconductors, RF Electronics, LED, Displays, Image Sensors, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management.

The “More than Moore” company Yole, along with its partners System Plus Consulting, PISEO, Blumorpho and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

- Consulting & Financial Services: Jean-Christophe Eloy (eloy@yole.fr)
- Reports: David Jourdan (jourdan@yole.fr)
- Press Relations & Corporate Communication: Sandrine Leroy (leroy@yole.fr)

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