LYON, France – October 3rd, 2019: MicroLEDs are drawing an increasing amount of attention. Startups have raised more than US$800 million to date, including at least US$100 million in 2019. It is estimated Apple has spent in the range of US$1.5 to US$2 billion on the technology over the last five years. Panel makers such as Samsung Display, LG Display, AUO or Innolux have also significantly increased their efforts...

Under this dynamic context, Yole Développement (Yole) is continuing its investigations towards microLED technologies and related applications. In addition to a wide collection of reports focused on the display applications, the market research and strategy consulting company proposes today a comprehensive overview of the microLED industry with a new report, titled MicroLED Displays. Under this new technology and market analysis, Yole details the technology status and trends including epitaxy, microLED efficiency versus OLED, assembly processes and equipment, light management and color conversion. The company also presents a specific section focused on yield and defect management with status and roadmaps, providing a technical and a cost analysis of the different strategies.

This new report is an opportunity for the consulting company to deliver its analysis of microLED applications: why is the smartphone market segment so challenging? Are TV applications still possible or just a pipe dream? Could we expect business opportunities within the smartwatch sector? Yole analysts offer a snapshot of...
the microLED industry with a clear understanding of the technology status and related markets.

“Without doubts, microLEDs are today progressing on all fronts,” announces Principal Display Market & Technologies Analyst, Eric Virey, PhD. at Yole. Under its new MicroLED report, Yole reveals the status of the technology and its progressive adoption.

Patent filings are growing exponentially and technology is progressing. The external quantum efficiency of blue and green microLED chips has more than doubled over the past 24 months. Some transfer and assembly processes are reaching performance close to what is required to enable some microLED consumer applications.

Progress is also visible in the proliferation of prototypes presented over the last 18 months by close to 20 companies. Zine Bouhamri, PhD. Technology & Market Analyst and part of the Display team at Yole explains: “The demos cover a broad range of display types, sizes and technologies. Native RGB or color converted displays on TFT backplanes are offered by many companies, with some examples including Playnitride, CSOT, Samsung, LG, glō, AUO, eLux, and Kyocera. Lumioede has developed native RGB or color converted displays on monolithically integrated LTPS.”

Microdisplays on CMOS backplanes are also demonstrated by companies including Plessey, glō, Lumens, JB Display, Sharp and Ostendo. Finally, discrete microdriver ICs have been developed by X-Display. The multiple prototypes based on TFT backplanes give credence to the idea that microLED displays could leverage existing panel maker capacity, thereby simplifying and streamlining the supply chain.

“Equipment makers have taken notice and are starting to develop microLED-specific tools for assembly, bonding, inspection, testing and repair”, details Eric Virey from Yole.

LED makers are also showing interest, with San’an planning to invest US$1.8 billion to set up a mini and microLED manufacturing base. Osram, Seoul Semiconductor, Nichia or Lumileds are also increasing their activity and Playnitride is completing its first microLED pilot line.

However significant roadblocks are still in place for key applications… For many of them, economics are pushing die size requirements below 10μm. This compounds efficiency, transfer and manufacturability challenges and despite significant improvement, small die efficiency remains low. In most cases, display efficiency based on this technology still can’t match that of OLED. Significant effort is therefore needed to further improve the internal quantum efficiency, light extraction and beam shaping of green and red microLED chips…

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1 TFT : Thin Film Transistor
2 LTPS : Low-Temperature Polysilicon
3 CMOS : Complementary Metal Oxide Semiconductor
4 OLED : Organic Light Emitting Diodes
For microLED companies, the first few prototypes provide strong return on experience but maturing toward consumer-grade displays could require thousands more. Startups are entering the valley of death: many might fail to raise enough money to successfully go through this more capital and resource intensive phase. Support and partnership with large display makers or OEM, either as strategic investors or development partners is critical.

**Yole and the Display Industry:**

Yole Group of Companies is strongly committed to the display industry and related technologies. It has been investigating the sector for many years in order to identify and analyze disruptive technologies and establish business opportunities.

The technology & market report, *Next Generation TV Panels: New Technologies, Features and Market Impact* illustrates Yole’s expertise in this area, going beyond microLEDs. In that report, Yole’s Display team proposes a comprehensive overview of key technologies, main drivers and obstacles for new TV features. “The TV panel industry needs today a game-changer,” asserts Eric Virey from Yole. “With unit sales stagnating, TV panel makers are entering what is likely to be a period of prolonged excess capacity. This translates into commoditization and shrinking profitability in an industry that is very capex-intensive…”

What technologies and manufacturing strategies are deployed by individual panel makers? How can Korean and Japanese manufacturers defend against China’s ascendance? And what are the capacity constraints and the overspending risks?

The market research and strategy consulting company is offering today a deep insight in the display industry, through emerging technologies and their impacts on the competitive landscape. A detailed description of Yole’s Display reports are available on i-Micronews.com.

In addition, Yole will present key results of their microLED analysis at **IDW 2019** in Japan (November 27-29 – Sapporo, Japan):

- Title: “Impressive Technologies for MicroLED Displays”
- Date: November 29, 2019 at 3:20 PM
- Speaker: Zine Bouhamri, Technology & Market Analyst, Displays, Yole Développement

How to get this presentation? Visit [i-Micronews.com, presentations section](https://www.i-micronews.com) to download the slides.

Stay tuned!
ABOUT THE REPORTS:

**MicroLED Displays 2019**
Significant progress over the last 18 months, but many challenges remain before ramping up for large volume consumer applications. – Performed by Yole Développement (Yole)

**Companies cited in this report**

**Authors of the report**
- **Eric Virey**, PhD. serves as a Principal Display Market and Technologies Analyst within the Photonics, Sensing & Display division at Yole Développement (Yole).
  Eric is a daily contributor to the development of the Display activity at Yole, with a large collection of market and technology reports on display technologies, Quantum Dots, MicroLEDs, TFT backplanes as well as multiple custom consulting projects: business strategy, identification of investments or acquisition targets, due diligences (buy/sell side), market and technology analysis, cost modelling, technology scouting, etc.
  Eric has spoken in more than 50 industry conferences worldwide over the last 10 years. He has been interviewed and quoted by leading media over the world including: The Wall Street Journal, CNN, Fox News, CNBC, Bloomberg, Financial Review, Forbes, Technology Review, etc. He is also a regular contributor to various display industry media and organizations.
  Previously Eric has held various R&D, engineering, manufacturing and business development positions with Fortune 500 Company Saint-Gobain in France and the United States.
  Eric Virey holds a PhD in Optoelectronics from the National Polytechnic Institute of Grenoble. He is currently based in Portland, OR.
- **As a Technology & Market Analyst, Displays, Zine Bouhamri**, PhD is a member of the Photonics, Sensing & Display division at Yole Développement (Yole).
  Zine manages the day to day production of technology & market reports, as well as custom consulting projects. He is also deeply involved in the business development of the Displays unit activities at Yole.
  Previously, Zine was in charge of numerous R&D programs at Aledia. During more than three years, he developed strong technical expertise as well as a detailed understanding of the display industry.
  Zine is author and co-author of several papers and patents.
  Zine Bouhamri holds an Electronics Engineering Degree from the National Polytechnic Institute of Grenoble (France), one from the Politecnico di Torino (Italy), and a Ph.D. in RF & Optoelectronics from Grenoble University (France).

As well as:
  With flat unit-volumes, heavy capex, and low profitability, the TV panel industry is at a crossroads and must prepare for the next generation of TVs. – Performed by Yole Développement (Yole)
- **Next-Generation Human Machine Interaction in Displays 2019**
  Sensors directly integrated in displays: still a long way to wow! – Performed by Yole Développement (Yole)
- **MiniLED for Display Applications: LCD and Digital Signage**
  MiniLEDs bring new strength to LCD players in the battle against OLED and enable increased LED adoption on digital signage – Performed by Yole Développement (Yole)

ABOUT YOLE DEVELOPPEMENT

Founded in 1998, Yole Développement (Yole) has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon
and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS & Sensors - Imaging - Medical Technologies - Compound Semiconductors - RF Electronics - Solid State Lighting - Displays - Photonics - Power Electronics - Batteries & Energy Management - Advanced Packaging - Semiconductor Manufacturing - Software & Computing - Memory and more...

The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business. For more information, visit www.yole.fr and follow Yole on LinkedIn and Twitter.

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