

MicroLEDs show progress on all fronts: have they reached escape velocity?¹

Cost is the biggest challenge, but Apple and Samsung are carving paths toward the consumer.

OUTLINE:

- **COVID-19 outbreak:**
The COVID-19 outbreak complicated cross-border collaborations and tool installations, slowing down developments in 2020 and 2021.
Nevertheless, the momentum is stronger than ever, and we see many positive factors.
- **Cost challenges:**
The science is known: microLED is a massive engineering and manufacturing project.
Cost is the number one challenge.
A 20x to 50x reduction is required to address consumer applications with the exceptions of AR² and wearables.
- **Ecosystem:**
After years of limited effort, slow progress, and uncertain prospects, MicroLED could now be reaching escape velocity, thanks to increased funding, resources, prospects, and the availability of commercial tools that are speeding up development.
Samsung and Vuzix (with JB Display) are introducing the first commercial microLED products in 2021.

*“The display industry is currently favorable to microLED: China won the LCD³ war, the industry is turning its focus to technologies that deliver differentiation and high margins.” states **Eric Virey, Ph.D., Principal Analyst, Technology & Market, Displays at Yole Développement (Yole)**. He adds: “Helped by a COVID-driven demand boost, it has swung back to profit and is generating cash to fund new technologies. While the LCD business model needs high-volume commodity products to absorb huge fab costs and make money on premium products, microLED could see CapEx-light operations focused on serving premium markets”.*

¹ Extracted from:

MicroLED Displays Market, Industry and Technology Trends 2021 report, Yole Développement, 2021

MicroLED Displays – Intellectual Property Landscape and Analysis 2021, Yole Développement, 2021

² AR: Augmented Reality

³ LCD: Liquid Crystal Display

In this context, Yole provides in-depth investigations of disruptive display technologies and related markets to identify the latest innovations and business opportunities. Therefore, Yole launched the MicroLED Displays – Intellectual Property Landscape and Analysis 2021 report at the beginning of 2021. The report details deep insights into the status of microLED display technologies, identifying emerging technologies and trends for each technology node.

In addition, released today, the MicroLED Displays Market, Industry and Technology Trends 2021 report presents market trends and forecasts, supply chain developments, technology trends, technical insights and analyses, take-aways and outlook, and an in-depth understanding of the ecosystem and strategies of the leading players.

What is the status of microLED technology? What are the recent developments? What are the remaining pinch points? Which applications could microLED displays address and when? Who are the suppliers to watch, and what innovative technologies are they working on? Yole presents today its vision of the microLED display industry.

Has microLED display industry reached escape velocity?

(Source: Microled Displays - Market, Industry and Technology Trends 2021 report, Yole Développement, 2021)



As analyzed by Yole’s team in the new MicroLED Displays Market, Industry and Technology Trends 2021 report, Apple put microLED on the map when it acquired LuxVue. Display makers were initially skeptical but now believe that, while challenging, microLED displays might be credible contenders in some applications. As a result, money and resources are flowing into microLED, fueling a virtuous circle with faster developments, and improving prospects attracting further investments.

According to **Zine Bouhamri, Ph.D., Team Lead Analyst, Imaging & Display Activities at Yole**: “LCD or OLED⁴ didn’t take off until HVM⁵ equipment became available.

⁴ OLED: Organic Light Emitting Diode

⁵ HVM: High Volume Manufacturing

Equipment makers are now offering microLED-dedicated tools, and, although hindered by a lack of standard processes, some are developing one-stop solutions, including transfer, inspection and repair”. Mass transfer is no longer considered a fundamental roadblock by most players. Many issues remain, but the industry now sees a clearer runway. Commercial tools from ASMPT, Toray, Coherent/3D Micromac, and others using different processes accelerate development. More are coming from TDK, V-Technology, Besi, Bolite/Contrel, etc. Samsung and Vuzix (with JB Display) are introducing the first commercial microLED products in 2021. They won’t yet move the needle of the display industry but are positive developments.

LCD vs. microLED cost reduction paths

(Source: Microled Displays - Market, Industry and Technology Trends 2021 report, Yole Développement, 2021)



Strong momentum doesn’t guarantee success: many technical and supply chain challenges could still derail microLED. Many solutions look great on paper, but real-life process integration in a high-volume manufacturing environment is much more challenging. Cost is the #1 obstacle and is still 20x to 50x too high for consumer products.

LCD cost decreased 300x, from US\$30k/m² to US\$100/m² in 25 years. However, LCD started with a blank canvas. Cost reduction opportunities lay across the board: materials, equipment, processes, etc. The bulk of the reduction was achieved by generation scaling. MicroLED, on the other hand, exists at the intersection of the mature Semiconductor, LED, and Flat Panel Display industries. Fewer contributors present 300x cost reduction opportunities, but in many cases, microLED hasn’t yet leveraged technologies and wafer processing equipment that could help deliver significant improvements.

For Eric Virey: “Apple clearly saw that: the company is driving its supply chain to 200 mm wafer to unlock the fantastic efficiency of the mature SEMI manufacturing philosophy that has remained untapped by the LED industry”.

This risky and initially costly bet could pay off, giving the company a unique advantage when addressing the smartphone market, which requires very small and low-cost yet-high performance chips.

Most other players are, for now, on the opposite path, building knowledge and looking at cost-reduction on existing 4” LED fabs while waiting for more clarity in the prospects of microLED. This approach could work for 1st products (B2B TV, etc) or small displays but likely won’t deliver the small die size and performance required for HVM of consumer TVs or smartphones.

Throughout the year, *Yole Développement* publishes multiple display-dedicated reports and analysts take part of key conferences and events.

OLEDs WORLD SUMMIT

In this regard, do not miss the *OLEDs World Summit 2021* and **Eric Virey’s** presentation: “Next generation displays: are MicroLED in the race?”, on September 14th. Register [here!](#)

Moreover, **Zine Bouhamri** participated to the 28th international workshop on active-matrix flat-panel displays and devices: discover it [here](#).

Experts also deliver various key presentations: discover **Eric Virey’s** latest ones on *i-Micronews*, at the [display section](#):

- “From Lab to Fab: Challenges and Requirements for High-Volume MicroLED Manufacturing Equipment” - Display Week 2021
- “Quantum Dots, OLED, MiniLED, MicroLED, NanoLED: Technology Landscape for Next-Generation TVs” – Techblick Display & Lighting: Innovation & Market Trends 2021.

Make sure to be aware of the latest news coming from the industry and get an overview of our activities, including interviews with leading companies and more on [i-Micronews](#). Stay tuned!

Press contacts

Sandrine Leroy, Director, Public Relations, sandrine.leroy@yole.fr

Marion Barrier, Officer, Public Relations, marion.barrier@yole.fr

Le Quartz, 75 Cours Emile Zola – 69100 Villeurbanne – Lyon – France – +33472830189

www.yole.fr- www.i-micronews.com – [LinkedIn](#) – [Twitter](#)

About our analysts

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.

Zine Bouhamri, PhD. is Team Lead Analyst, Imaging & Display Activities at Yole Développement (Yole). Zine is managing the expansion of the technical expertise and the market know-how of the company. In addition, he actively assists and supports the development of dedicated imaging collection of market & technology reports and monitor as well as custom consulting projects. Prior to Yole, Zine oversaw 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. He is author and co-author of several papers and patents. Zine Bouhamri holds an Electronics Engineering Degree from the National Polytechnic Institute of Grenoble (FR), one from the Politecnico di Torino (IT), and a Ph.D. in RF & Optoelectronics from Grenoble University (FR).

About the reports

MicroLED Displays Market, Industry and Technology Trends 2021

Strong momentum for MicroLED with progresses on all fronts. Cost is the biggest challenge, but Apple and Samsung are carving paths toward the consumer. – Performed by Yole Développement

Companies cited:

3D Micromac (DE) Aixtron (DE), Applied Materials (US), Aledia (FR), Allos Semiconductor (DE), Advanced Powerch (KR), Aerotrans Tech. (TW), AMEC (CN), Apple (US), AQLaser (KR), ASMPT (SG), AUO (TW), Attolight (CH), BOE (CN), Bolite (TW), CEA-LETI (FR), Charm Engineering (KR), CIOMP (CN), Coherent (US), Comptek (FI), Contrel (TW), Compound Photonics (US), CSOT (CN), Cyberoptics (US), eLux (US), eMagin (US), Enkris (CN), ENNOSTAR (TW), EpiLED (TW), EpiPix (UK), Epistar (TW), Facebook (US), Flex Photonic (CN), Foxconn (TW), Gamma Scientific (US), glö (SE/US), GlobalFoundries (US), Goertek (CN), and more...

MicroLED Displays – Intellectual Property Landscape and Analysis 2021

Joining Apple, Samsung, LG, XDisplay, PlayNitride, Facebook and others, newcomers are accelerating microLED patenting activity. – Performed by Yole Développement

Companies cited:

Acer, AGC, Aledia, ANK, Aoshi, Apple/LuxVue, Applied Materials, Appotronics, APT, ASTI, AU OPTRONICS, BOE, CEA, CEC Panda, Central South University, Century Display, Changelight, HKC, CIOMP, Comptek, Cooledge, Corning, Cree, Dai Nippon Printing, Elux, EPilight, EPistar, Erised, Facebook/Oculus, Foxconn, Fuzhou University, General Interface Solution, GLO, GlobalFoundries, Goertek, Google/X Development, Guangdong U. of Technology, Gwangju Inst. of Science & Tech., HC Semiteck, HCP Technology, Himax, HiSense, HKC, HKUST, HP, Huawei, Huazhong U. of Science & Tech., IBM, IMEC, Innolux, Intel, ITRI, and more...

Related reports:

- [Next Generation TV Panel Technology and Market Trends 2020](#)
- [Displays and Optics for AR & VR 2020](#)
- [Microdisplays – Market, Industry and Technology Trends 2020](#)



Press Release

About Yole Développement

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... [More](#)

For more information and images, please visit our website [i-Micronews](#)

###