

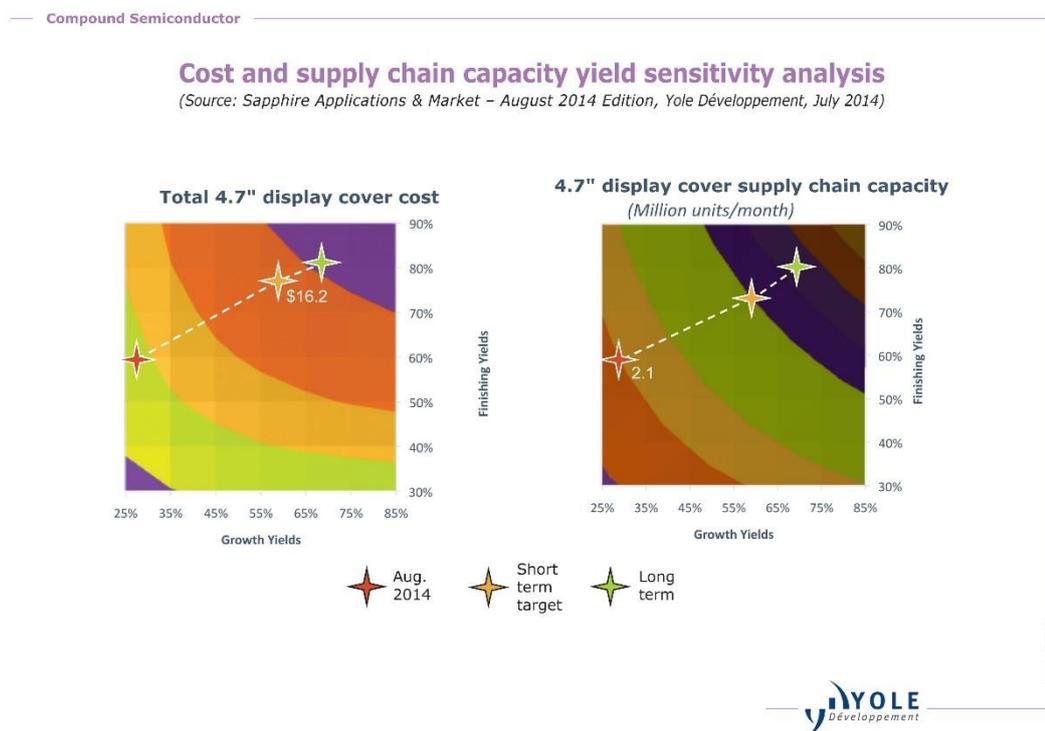
## Apple saved the sapphire industry in 2013 and could transform it in 2014: the revolution will happen...

**Sapphire Applications & Market: from LED to Consumer Electronic – August 2014 Edition**

LYON, France – August 5, 2014 – Yole Développement (Yole), the strategy consulting company releases this week its *Sapphire Applications & Market: from LED and to Consumer Electronic* report (August 2014 edition). In 2013, Apple completely saved the sapphire industry. This year, in 2014, Apple could transform this industry. Will the revolution happen?

All these results are part of Yole's report: analysts provide an updated analysis of new consumer electronic applications (smart watches, camera lens and fingerprint ...). They also highlight the GTAT/Apple partnership: display cover, manufacturing cost modeling, supply chain capacity analysis, yield impacts and paths to cost reduction.

This new report also provides an analysis of Apple sapphire related patents as well as recent sapphire substrates price trends and forecast and updated supply and demand analysis.



The sapphire industry recently ended a long period of depressed pricing and achieved US\$936 million in revenue for wafer products in 2013. Recovery was helped by an increase in LED demand due to accelerating adoption in general lighting and a resilient LCD backlight market. But the saving grace was new consumer electronic (CE) applications: camera lens and fingerprint reader covers, mostly driven by Apple in 2013. Adoption at other vendors is progressing at a slower pace than anticipated in 2014. LG even reversed the trend with its

flagship cellphone: its G2 model featured a sapphire lens cover but the G3 uses glass. However, Yole's analysts are optimistic for the mid-term with adoption increasing in Taiwan and China. In addition, new applications such as LED filaments could further increase sapphire consumption.

After almost 2 years of losses, the price of sapphire cores increased more than 50% in 2013. In Q2-2014, tier-1 sapphire vendors were finally selling at breakeven prices. However, Yole expects that prices will decrease again in Q4.

In November 2013, GTAT and Apple announced partnership to set up a large sapphire manufacturing plant in Mesa, Arizona. Yole's thorough analysis concluded that the objective of the investment is to produce sapphire display covers for cell phones.

*"Apple plans to introduce both a 4.7" and a 5.5" model this year", announces Dr Eric Virey, Senior Analyst at Yole. "We believe that prices for the sapphire cover have been agreed upon and locked by contract, based on yield assumptions reflecting reasonable expectations from all partners. We used yield assumptions derived from other Tier-1 sapphire makers in the LED industry to model the cost for both sizes. For the finished 4.7" display, we estimate a cost of \$16, including \$6.7 at the slab (material) level. On the longer term, we see a path for <\$13", he adds. Under those assumptions, Yole also estimates that the supply chain could deliver more than 5 million display covers per month.*

But the challenges in term of ramp up execution are unprecedented in the industry. Recent checks point to bottlenecks at various levels of the process with lower than anticipated crystal growth and finishing yields. As of August 2<sup>nd</sup> 2014, Yole estimates that the supply chain capacity is currently ~2.1 million units per month. If yields don't improve rapidly, Apple walking away from sapphire is still a possible scenario. The company believes that moderate quantities of supplemental material is currently being sourced from GTAT equipment customers in China. But even if all partners manage to improve yields rapidly, Yole's analysis still excludes the possibility that sapphire can be used on all models of the new 2014 iPhone. However, Yole still expects that at least one model (SKU) will be offered in 2014 with a sapphire cover. This would allow Apple to plant a stick on the ground and make a statement. Scarcity could even be a good marketing tool providing it doesn't last too long and that the supply chain catches up quickly. Releasing at least one SKU with sapphire would allow Apple to gage customer response and decide if it should adopt sapphire on more models, plan for more investment in the supply chain or simply walk away.

For the procurements of wafers for camera lens and fingerprint reader covers, Apple is now taking a back seat and letting their Chinese finishing contractors handle the sourcing. This resulted in accelerated commoditization (strong price pressure) and shifted large volumes toward Chinese sapphire vendors. Combined with current high levels of inventories, this has significantly impacted established vendors since the beginning of the year.

Procurement has started for the iWatch and is so far mostly benefiting Chinese vendors as well. Various designs have surfaced including one with a curved display ("2.5D design") which

would be more expensive to produce.”*In any case, we expect that Apple will keep tapping into the existing supply chain and let GTAT focus on display covers*”, says Eric Virey.

Yole’s report, August 2014 update, includes a thorough analysis of the GTAT/Apple deal. It explains key hypothesis of our cost model and provides thorough yield sensitivity analysis for cost and capacity. Cost, capacity and revenue models are presented for both 4.7” and 5.5” displays.

**About the report: Thin Film PZT for Semiconductor Application Trends & Technology Update**

- Author:



Eric Virey holds a Ph-D in Optoelectronics from the national Polytechnic Institute of Grenoble. In the last 12 years, he’s held various R&D, engineering, manufacturing and marketing positions with Saint-Gobain. Most recently, he was Market Manager at Saint-Gobain Crystals, in charge of Sapphire and Optoelectronic products.

- Publication date: December 2013.

- Companies cited in this report:

Aceplux Optotech, Aledia, AND, Apexcera, Apple, Asahi, Aurora Sapphire, Aurotek, Azzurro, Baltic Crystal, Biel, BIEMT, Bluestone, BONS Technology, Bridgelux, Canyang, Chi Mei Opto, Corial, Corning, Cosmoled, Cree, Crystal Applied Technology, Crystal Optech, Crystaland, Crystalwise, C-Sun, CT Lab, DK Aztec, Electech (ETI), Epilight, Epistar, Everland, Everlight, EVG, Exiton, Formosa epitaxy, GAPSS, GCL Opto, Genesis Photonic, Glo, GTAT, Guangdong Saifei Sapphire Technology, Hanmak, Hansol Technics, HTOT, HC Semitek, Hefei Crystalbridge, Hualeled, Huga, Hyperion Geocrystal, Iljin Display, Kama Crystal, KQT, Kyocera, Lammbos, Lattice Power, Lens Tech, Lextar, LG Innotek, LG Siltron, LGS, Lucemitek, Meyer Burger, Monocrystal, Namiki, Nanjing J-Crystal Photoelectric (NJC), Nantong Tongfan, Nationstar, Nichia, OCI, Oppel Lighting, Osram-OS, Peregrine Semiconductor, Philips Lumileds, Plessey, Procrystal, Rigidtech, Rofin Lasag, Rubicon, Saifei Sapphire, Samsung, San Shi Semiconductor, Sanan, Sapphire Technology (STC), SAS, Seoul Viosys, Shangcheng Science & Technology, Shinkosha, Silan Azure, Silian Sapphire, Sinonitride, Soitec, Soraa, SSLM, Sumitomo Chemical, Sumitomo Metal Mining, SUSS MicroTec, Takatori, TDG Core, Tekcore, Tera Xtal (ACTC), theLED, Tianxing Lighting, Toyoda Gosei, Trinity Materials, TSMC, TXC, Tyntek, Ubilux, Union Light Technology, USI Opto, Walsin Lihwa, Yangzhou Zhongke.

- Rates: Euros 5,990.00 (Full report - Multi user license) – Euros 2,990 (Executive Summary) – For special offers and the price in dollars, please contact David Jourdan ([jourdan@yole.fr](mailto:jourdan@yole.fr) or +33 472 83 01 90).

**About Yole Développement – [www.yole.fr](http://www.yole.fr)**

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

The group supports industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to develop their business.



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