iNEMI

International Electronics Manufacturing Initiative

iNEMI 2007 Roadmap Executive Summary Optoelectronics Highlights

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Advancing manufacturing technology

Background

- **2007 Optoelectronic Roadmap focus on issues of interest to manufacturers of electronic equipment or to manufactures of equipment used in the assembly of electronic components and systems**

- **The Chapter identifies current trends in both market and technology drivers - provides a roadmap of the likely evolution of component in feeds - required future assembly processes**

- **Emphasis is on optoelectronic components available at JISSO Level 2 (primary packaging) and associated assembly issues (Level 2 to Level 3&4 assembly)**

Background

- **Optoelectronic product evolution is driven in diverging directions by technological optimization of the components for particular applications**
- **While there are common issues across a number of the applications, each one has substantial differences from the others**
- **Roadmap considered the commonalities and differences referenced to the following set of application areas:**
  - **Infrastructure communications (telecom, datacom and compute applications : mature market)**
  - **Short range communications (home and automobile entertainment systems : emerging market)**
  - **Intra-card communications (on-board optical interconnect : under development)**
  - **Sensing systems (health / biological, manufacturing / processing, automobile, and security / defense sensors : emerging markets)**
  - **LED lighting systems (commercial, consumer and auto applications: rapid growth phase)**
  - **Display systems (handheld and large formats: high volume rapidly evolving)**

Optoelectronic Technologies

Application Area	examples	key opto devices	key requirements	status
Illumination	LED flashlights, architectural lighting,	High brightness LEDs	Output power, color rendering, color temperature, color gamut, low cost (lm/$), efficiency (lm/W)	Emerging
Information communications	Long haul optical communications, television remote controls	Laser diodes, modulators, fast LEDs, fiber optics,	Modulation, low transportation loss/attenuation, low transmission penalties (dispersion, four wave mixing, etc)	Mature, with emerging areas
Displays	Projection displays, micro displays, traffic lights, brake lights	High brightness LEDs, multicolor lasers, LED panels (including OLED)	Low cost (lm/$), high pixel count, uniformity,	Mature, with emerging areas
Image capture	Cell phone cameras, night vision systems	CMOS & CCD focal plane arrays and variants	Low cost, low noise, uniformity, pixel yield	Mature
Data processing	Optical correlators (image & pattern recognition), optical computing systems	Non-linear optical properties, photorefractive materials, laser illumination	High non-linearity, high power sources, holography	Early
Sensing	Chemical process control, non-invasive health assessment, threat detection	Multi-spectral LED and lasers, low noise detectors, tunable lasers, leaky fiber	Short wavelength lasers, range of wavelengths, narrow or broad lines, spectral analysis, quantum dot tags	Emerging
Storage	CD & DVD disks and reader/writers, bar-code readers	High power, short wavelength laser diodes, segmented detectors	Good beam quality, stable spatial output	Mature, some emerging areas (405 nm)

Strategic Issues

- **Most device companies (or optoelectronics divisions of larger companies) are still not profitable**
- **Small volumes of components lead to limited ability to capitalize or innovate**
- **Design and production separation, associated with production moving to low labor rate countries, produces a temporary inefficiency**
- **This inefficiency will be remedied as the skill level in the regions near the new assembly plants increase and the design activity becomes centered near the production capability, whether within the original company or through an ODM mode**

Challenges

Technical Challenges.

- **Most of the technology needs are related to the specific applications and are dealt with in the individual sections**

- **The trend toward integration, observed in many applications, requires development in many areas of chip technologies, micro optical components and packaging, for building up the capability for generic optoelectronic systems in a package (SIP)**

Identified Gaps and Showstoppers

- **In spite of years of research on array packaging, array packages are still costly, with the result that array transceivers are still not widely implemented**
  - **Volumes are required to reduce cost, and to implement yield enhancement activities that bring cost down. However, the volumes will not be created until costs are lower**

Challenges

- **Cost-effective packaging is required for long wavelength single mode VCSELs.**
  - **The key factor limiting adoption of long wavelength VCSELs is currently chip performance, i.e. achieving robust performance over the full temperature range with good yields and demonstrated reliability**
  - **However, once this barrier has been overcome, the market will expect cost benefits of the VCSEL versus edge-emitters**
  - **This benefit will not necessarily be immediately obvious. While the vertically emitting nature of the VCSEL creates additional packaging options, the single mode alignment problem is quite similar to that for edge emitters- maybe even more difficult, since one does not currently have power to throw away in the alignment as one often does with edge emitters, at least at the shorter distances**
  - **Finding a packaging cost benefit of long wavelength VCSELs remains a gap**

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