UV, LED & EB Radiation Curing






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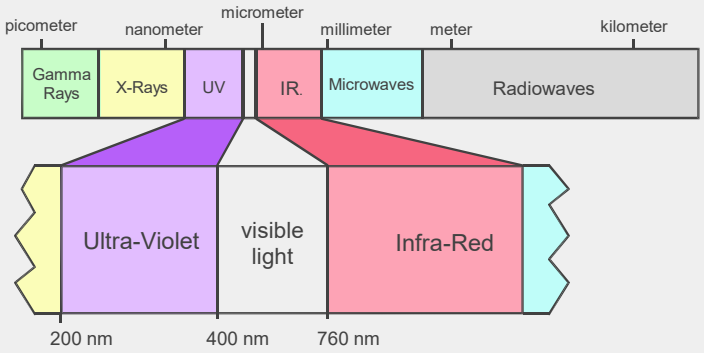
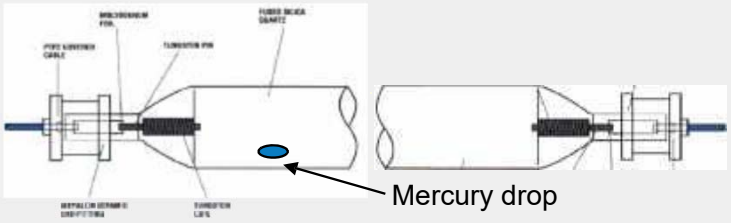
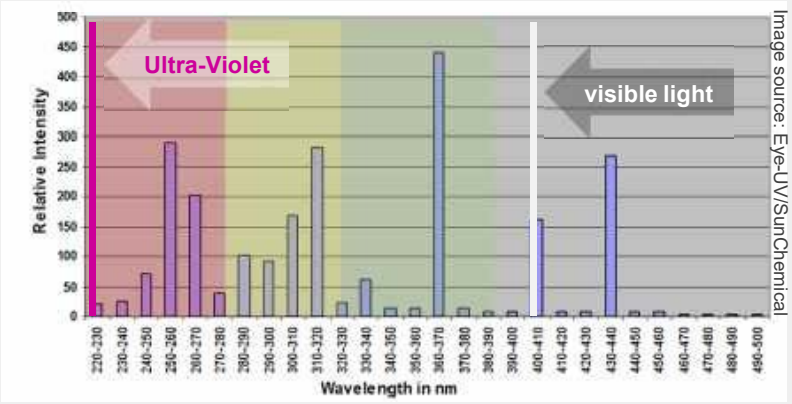
Radiation curing

- UV light = electromagnetic radiation
- shorter wavelength than visible light



Standard mercury vapour lamp (medium pressure)





Radiation curing

Composition of colours

Sheet Fed Ink	Gravure/Flexo Ink	EC (UV/EB) Ink
Pigments	Pigments	Pigments
Resins	Resins	Poly-/Oligomers
Oils	Solvents	Monomers
Additives	Additives	Additives
		Photoinitiators*
		* UV only

Curing / drying process

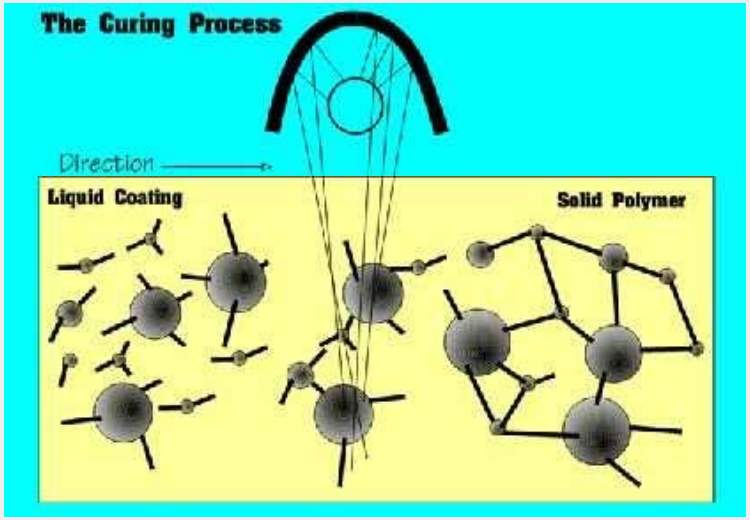
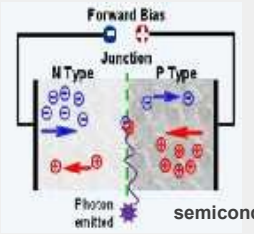


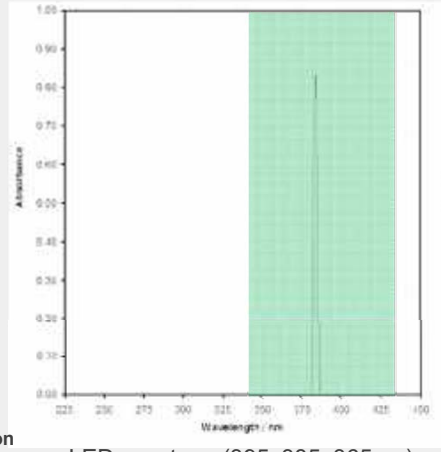
Image source: Sun Chemical

LED

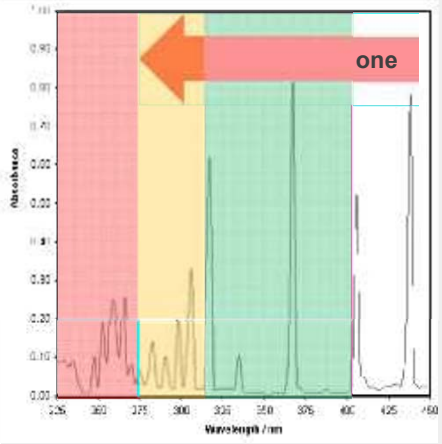


semiconductor

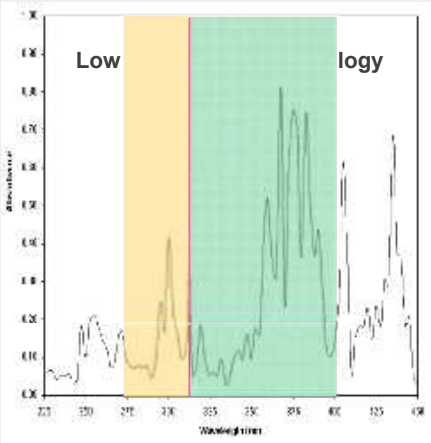
Accumulation of diode



LED spectrum (395, 385, 365nm)



Standard mercury spectrum



Spectrum iron-stabilised Hg

Set-up of diode

UV A	315-400 nm
UV B	280-315 nm
UV C	200-280 nm

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Electron beam curing (EB)

How does an electron beam work?

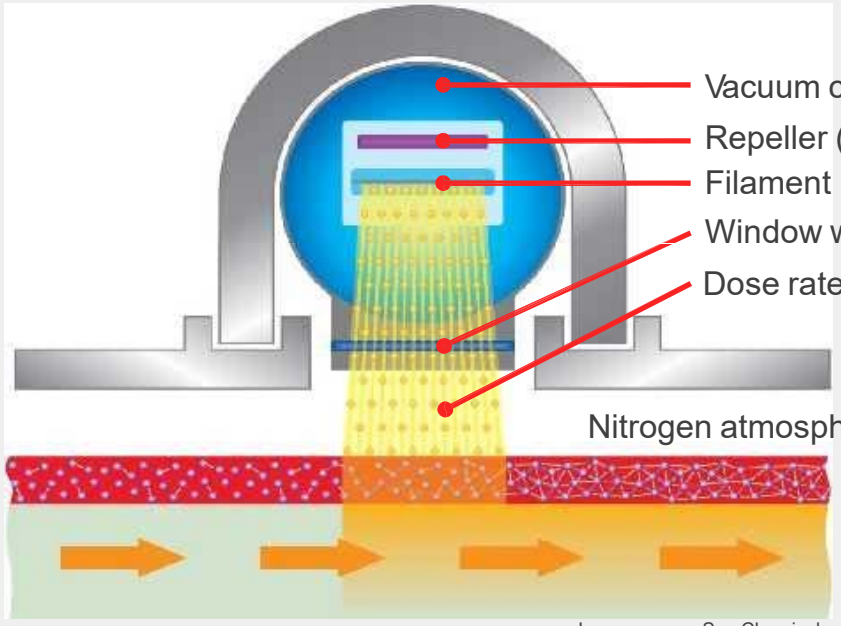

Image source: Sun Chemical

Standard UV

Applied in all print processes:

- Commercial print (paper, film)
- Label print (paper, film)
- Packaging print
  (paper, cardboard, film, foil, tinplate)
- Objects print
  (cups, tubes, bottles, 3-D objects)

Image source: Siegwerk
(www.siegwerk.com)

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Standard UV

Advantages of UV curing:

- Wide choice of substrates
- Easy handling
  (cleaning, no self curing, no explosion-protection)
- Quality intensification
  (gloss, resolution, abrasion resistance, fastness)
- Immediate processing
- VOC free

Image source: Flint Group (www.flintgrp.com)

Image source: Siegwerk
(www.siegwerk.com)

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Standard UV

Challenges of UV curing:

- Investment costs
  (lamp, extraction system)
- Operating costs
  (energy, maintenance, ink)
- Work place safety
  (ozone, handling of ink)
- Food packaging

Image source: Siegwerk (www.siegwerk.com)

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LED - UV

LED-UV curing used for:

- Commercial print (paper, film)
- Packaging print (paper, cartonboard, film & polycarbonate).
- Objects print (tubes, bottles, 3-D objects)

UV LED Curing Systems Benefits

- Solid State Technology.
- Easy Integration.
- Near Ambient array housing temperatures.
- Negligible heat transfer to cure surfaces.
- Instant on / off curing.
- No warm-up / cool- down cycles.
- No shutters needed.
- Diode life in excess of 20,000 hours.
- Consistent UV Output over time.
- No Mercury-filled UV bulbs
- No Ozone Production.
- No System Exhaust.
- No Conditioned Plant makeup air.
- No Radio Frequency emissions.
- Lower total cost of ownership.

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LED - UV

Advantages

- Energy-saving potential
  (no preheating time, pulsable circuit)
- No ozone creation
- Almost no heat input to substrate
- Long durability
- Constant radiation output
- Free of mercury

Challenges

- Food packaging
  (reactivity / limit of migration)
- Varnishes
  (curing of surface, yellowing, cost)
- Limited choice of raw materials
- Energy density – wavelength
- Young technology

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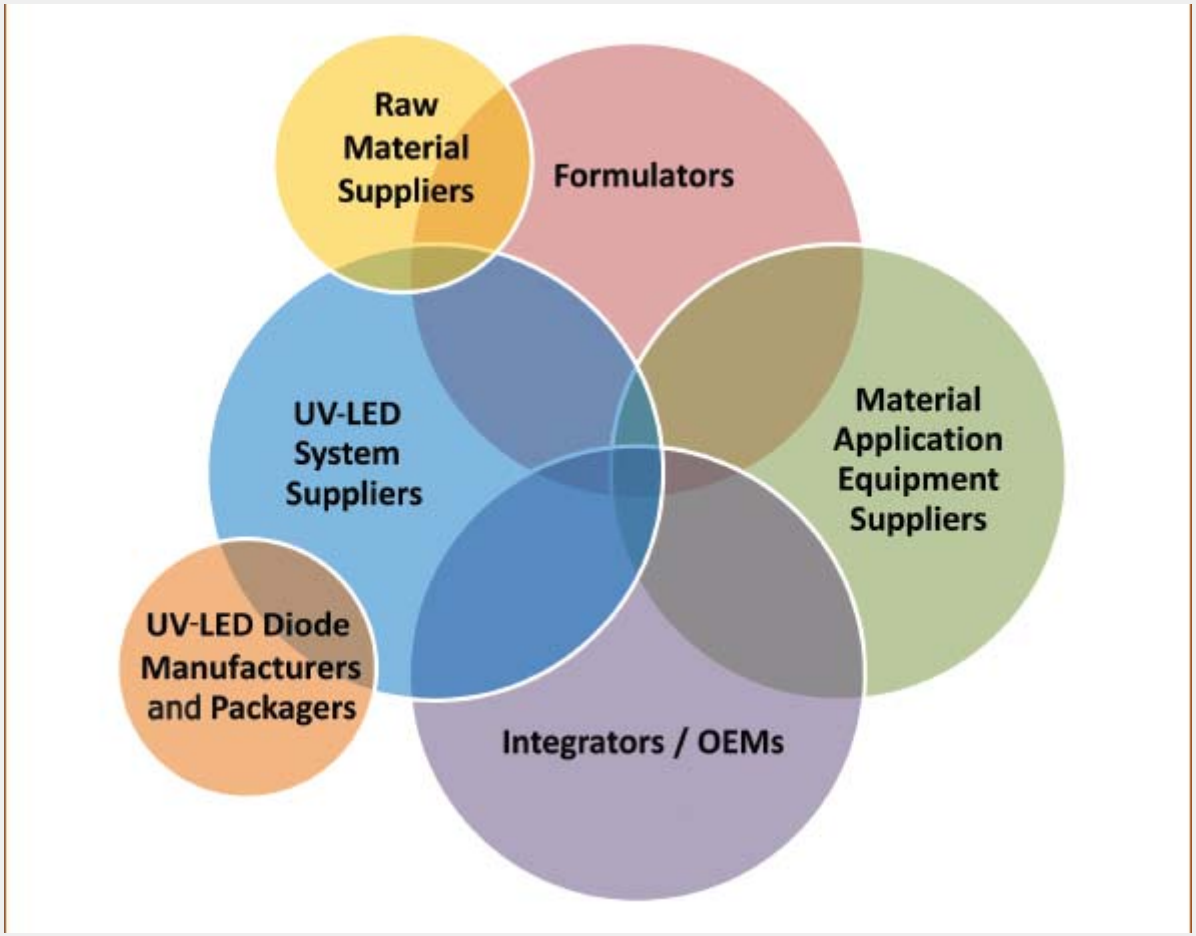
UV LED Technology at work



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EB technology

EB Offset

- Reel-fed offset printing
  (no lamp for sheetfed offset)
- Tension control of substrate
  (no intermediate drying)
- Flexible printing length
  (request of flexible packaging market)
- Inline printing machines of different machine manufacturers
- Central cylinder offset press

EB flexo

- Central cylinder flexo
  (wet on wet printing)
- Various developments of technology
  (some with intermediate drying)

Other developments

- Narrow web EB lamp
- Screen and gravure printing
- Inkjet

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EB technology – comparison

Advantages EB

- Process safety by controlled dose rate
- Low migration potential (photoinitiators, polymerisation)
- Low operating expenses (maintenance cycles, energy, spare parts)
- No heat input (IR) to substrate
- Free of mercury

Challenges EB

- Investment costs
- Influence on substrates
  - Discolouration of some PA, PVC, OPP formulations
  - PE heat-seal temperature
  - OPP- hot tack window
  - Some substrates show fission products
  - Smell of substrates containing chlorine

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Inkjet

- Established printing method for small print jobs
- LED-UV, as well in combination
- 3-D printing
- EB under development
- Many applications with exceptions to be developed

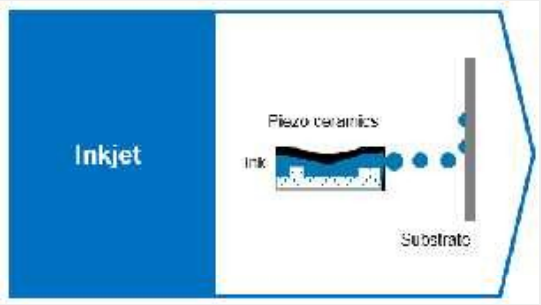

Image source: Siegwerk (www.siegwerk.com)

Inkjet

Advantages

- Prepress software-based only
- No set-up times
- Minimal wastage
- Individualization
- Non-contact printing

Challenges

- Speed of printing
- Dependency of print head – ink
- Food packaging
- Limited choice of raw materials
- Colour spectrum – branding
- Higher resolution

Future of Radiation Curing

- Low energy UV Curing.
- UV LED Curing.
- EB Curing
- Low Migration inks & Coatings.
- Hybrid inks which can be used for both UV & EB curing.

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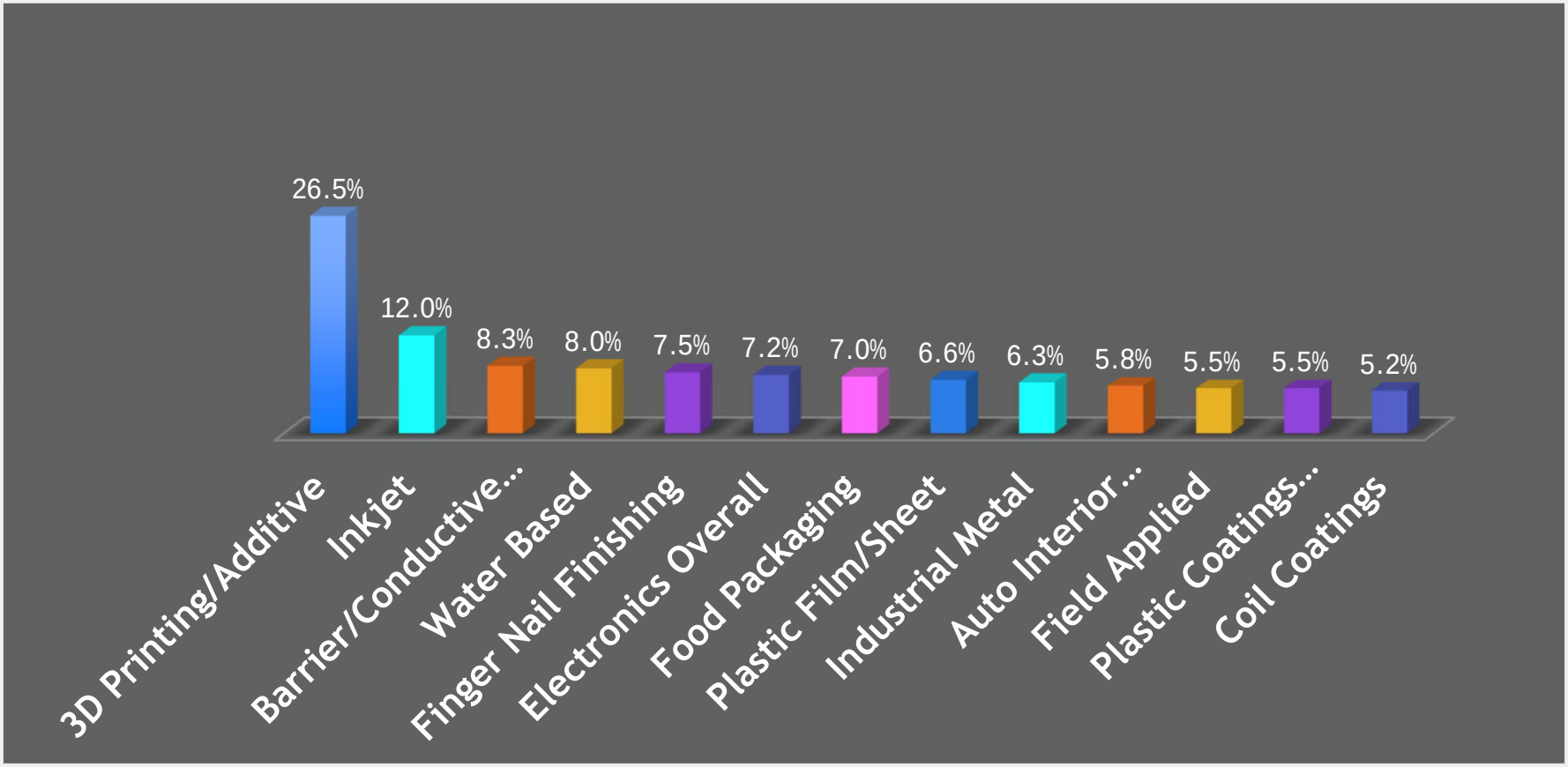
Forecast of UV+ EB growth in next 2 years.



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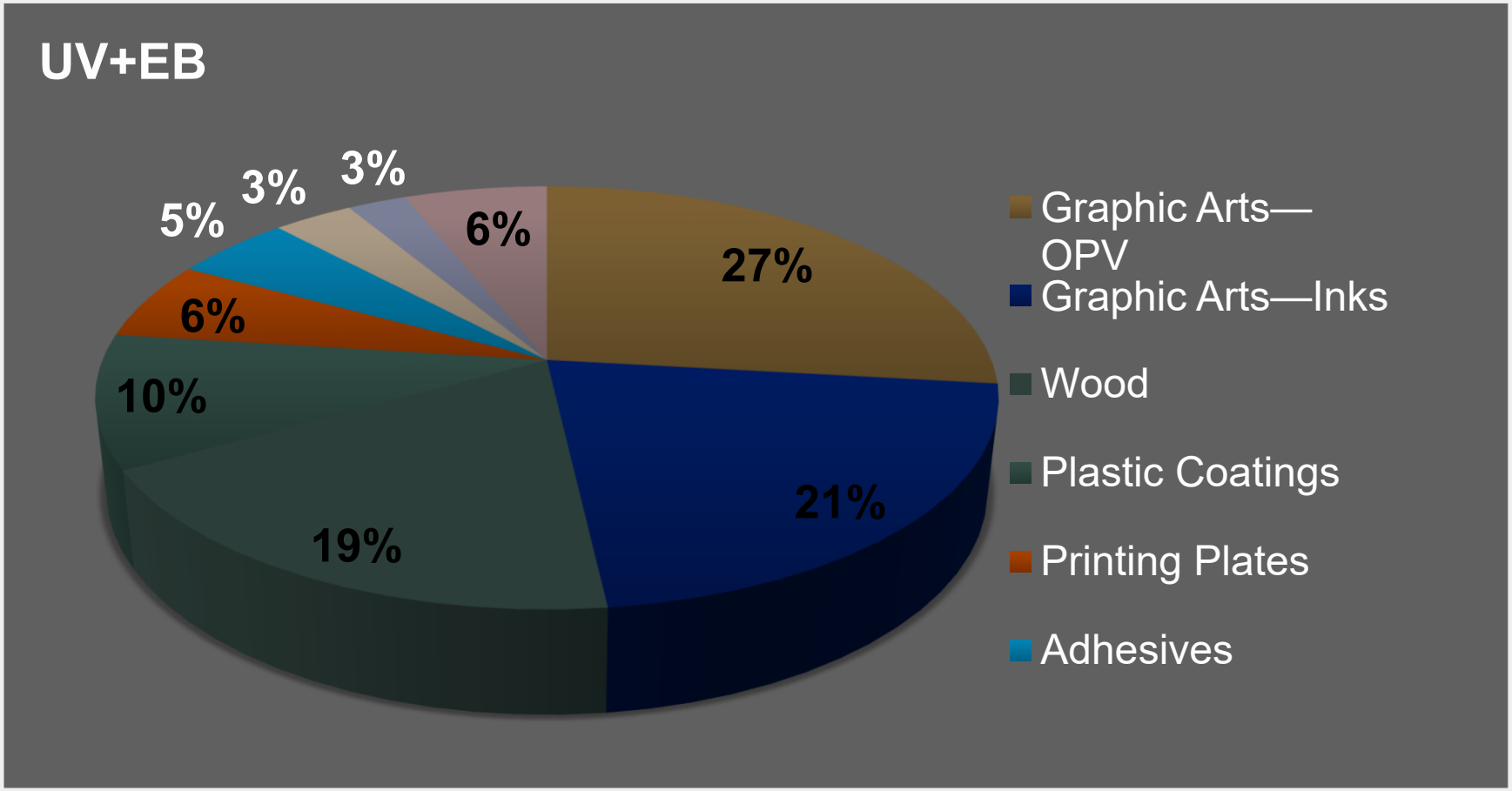
UV+EB products usage in various applications.



- Motivations for Using UV+EB

1. Increase Productivity
2. Improve Physical Performance
3. Enabling/New
4. Cost Effective

- Most Important Advances in Last Two Years:

1. UV LEDs
2. Better Adhesion
3. Improved rub / weather Resistance
4. Fast Cure Speeds
5. Lower Cost Materials

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Future of Radiation Curing

- Speed up manufacturing process.
- Reduction in production costs.
- Broaden market possibilities
- Broad substrates.
- Improve margins.
- Food safety.
- Health Safety.
- Environment.
- Safety.


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