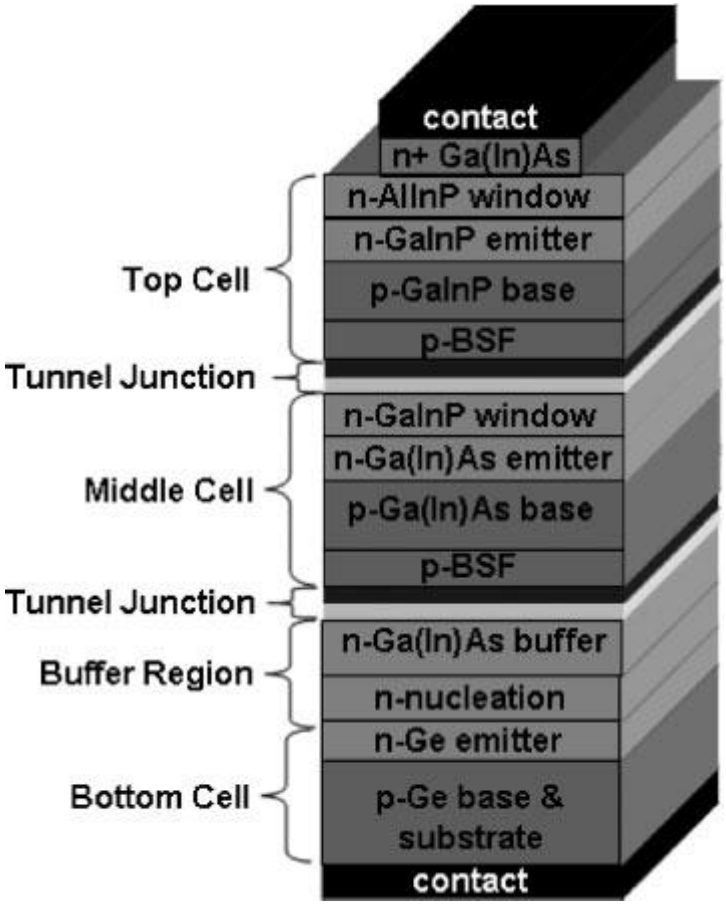
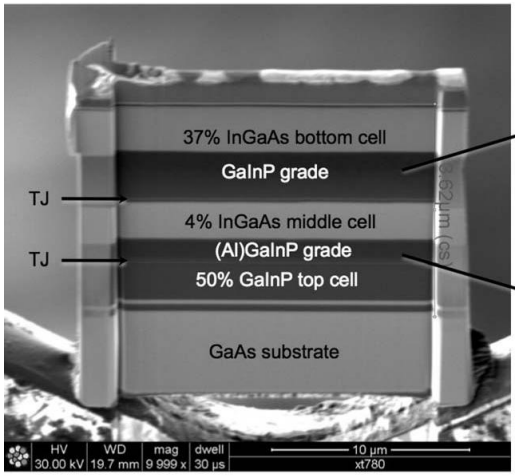
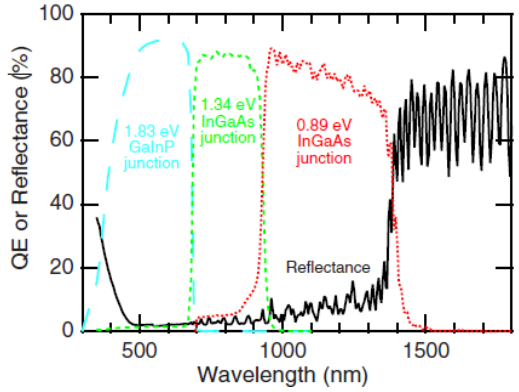
양자우물 (QUANTUM WELL) 이용 태양전지

Multijunction Solar Cell







APPLIED PHYSICS LETTERS **93**, 123505 2008

High- Efficiency Multijunction Solar Cells

Abstract

The efficiency of a solar cell can be increased by stacking multiple solar cells with a range of bandgap energies, resulting in a multijunction solar cell with a maximum theoretical efficiency limit of 86.8%. III–V compound semiconductors are good candidates for fabricating such multijunction solar cells for two reasons: they can be grown with excellent material quality; and their bandgaps span a wide spectral range, mostly with direct bandgaps, implying a high absorption coefficient. These factors are the reason for the success of this technology, which has achieved 39% efficiency, the highest solar-to-electric conversion efficiency of any photovoltaic device to date. This article explores the materials science of today's high-efficiency multijunction cells and describes challenges associated with new materials developments and how they may lead to next-generation, multijunction solar cell concepts.

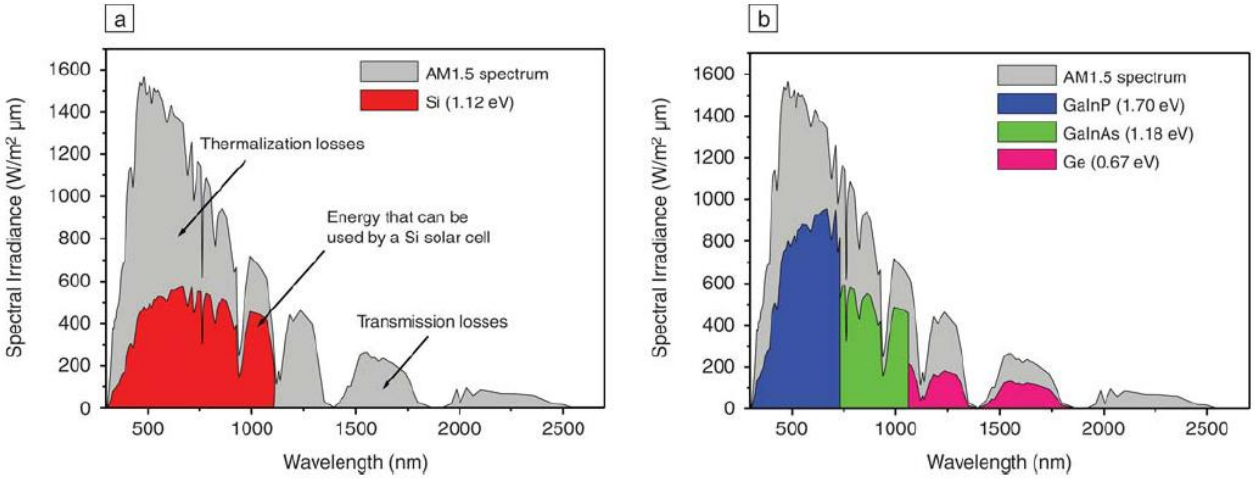
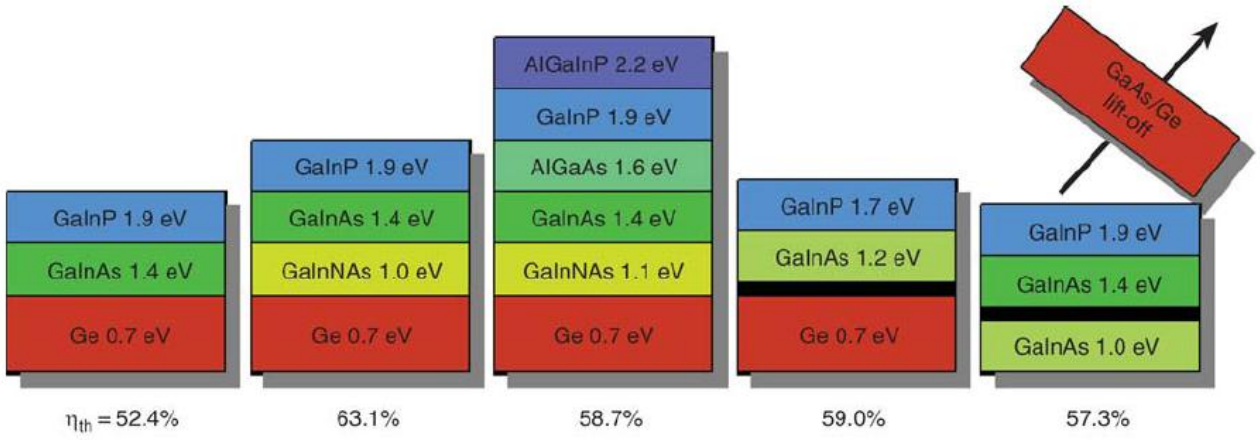


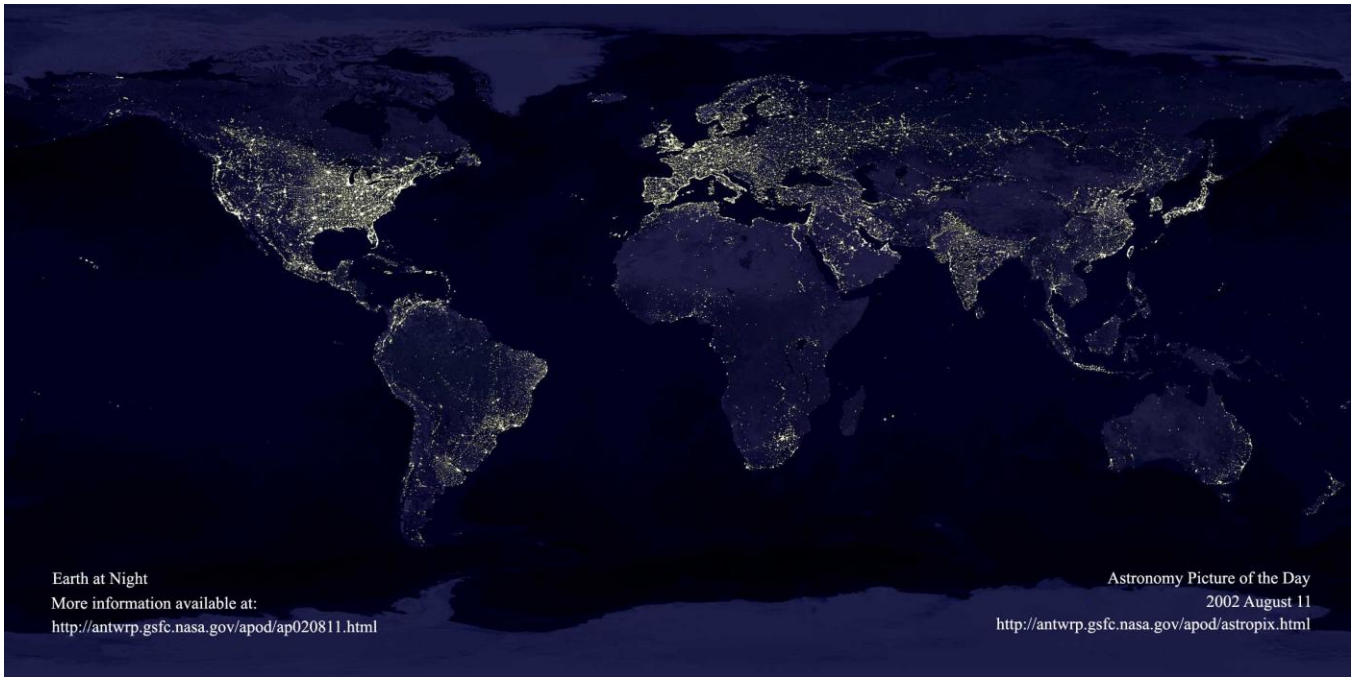
Figure 2. The AM1.5 solar spectrum and the parts of the spectrum that can, in theory, be used by (a) Si solar cells and (b) $Ga_{0.35}In_{0.65}P/Ga_{0.83}In_{0.17}As/Ge$ solar cells.

The limiting efficiency of a single junction is ~ 31%.
Why? Single junction solar cells do not absorb the significant fraction (20%) of the photons in the solar spectrum that are below the bandgap in energy.

The multi-junction cell (MJC) allows absorption of a wider range of wavelengths in the solar spectrum by combining solar cells of varying bandgap in a series (tandem) stack. A generalized theory based on 2–4 and beyond (infinite) number of bandgaps shows that the theoretical efficiency for four junctions is 71% under maximum concentration



Nanopatterned LED



LED Display

- LED TV

- 자연광 화질
- 친환경성(수은,납)
- 빠른 응답속도
- 29㎜ 초슬림 (기존 44.4mm)
- 낮은 소비전력 (기존 LCD TV보다 40% 이상 절감)

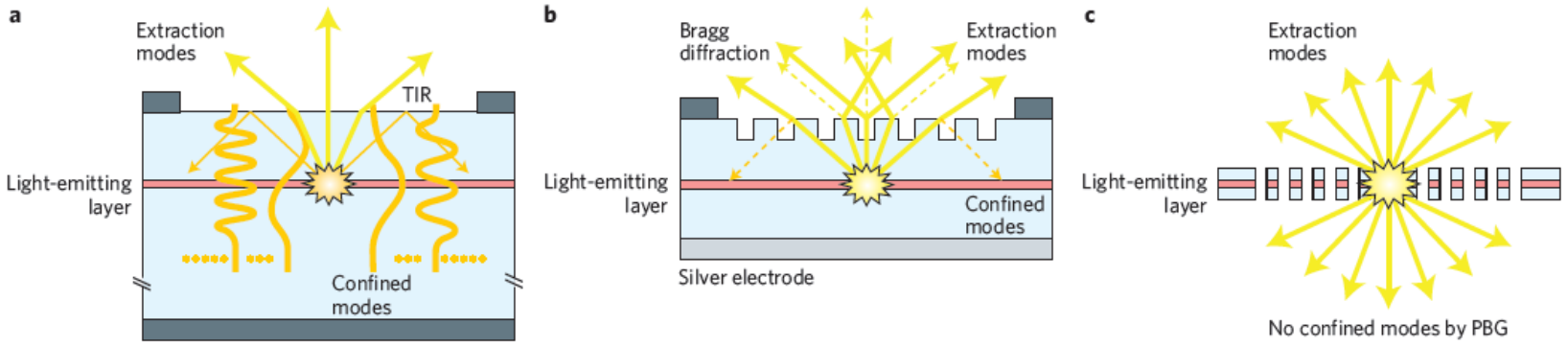
2009-03-17
디지털 타임즈

High Efficiency Issue in LED

LIGHT-EMITTING DIODES

Photonic crystal efficiency boost

LEDs are receiving great interest as candidates for next-generation lighting because they promise to reduce energy consumption enormously. However, to be a feasible solution their quantum efficiency needs to improve. Now, it seems that the incorporation of photonic crystals may be an answer.



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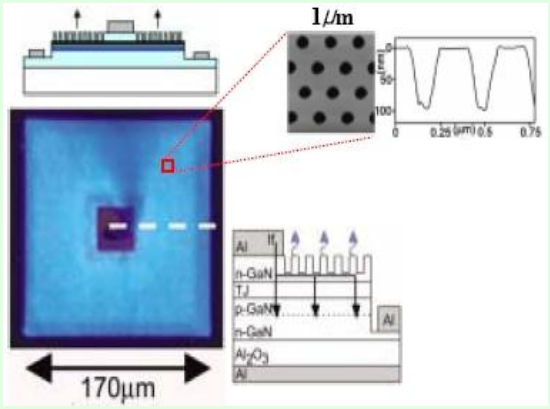
Applications of White LEDS

Lamps based on Luxeon White

LUMILEDS

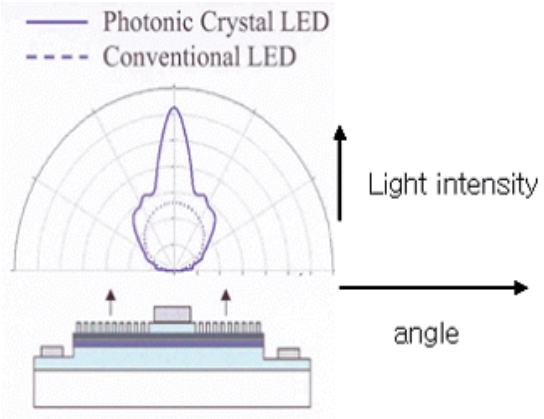
Photonic Crystals for

Wierer et al. (APL 2004, Lumileds)



: Ø200~250nm PC, 100nm DP
PCs are Fabricated by E-Beam Litho.

Photonic crystal LED
170 mm x 170 mm LED area
Photonic crystal formed into
the top GaN layer (250 nm holes)



Radiation pattern measurement
Intensity of the Photonic crystal
is better

- 조명 및 디스플레이 분야에서 **PC**활용에 대한 필요성 증대
  → **PC**에 의한 광효율 증대 효과는 입증
- 보다 정확한 형태, 보다 정확한 규칙성, 상용화 가능성

Appl. Phys. Lett., Vol. 84 (2004) 3885