

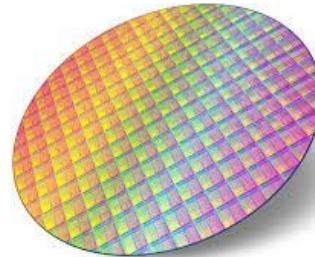
# Advanced Materials & Devices

(Nano-Electronics & Photonics: NEP)

(Semiconductor Device Research Laboratory: SDRL)

20-Apr-2019

- electronics: IV (Si)
- optoelectronics: III-V compounds (GaAs, InP,...)

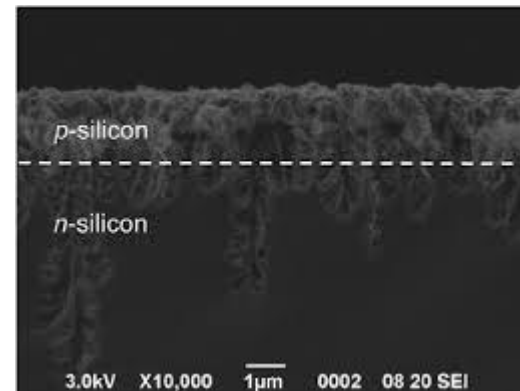
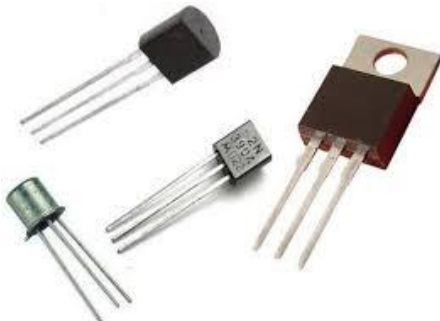
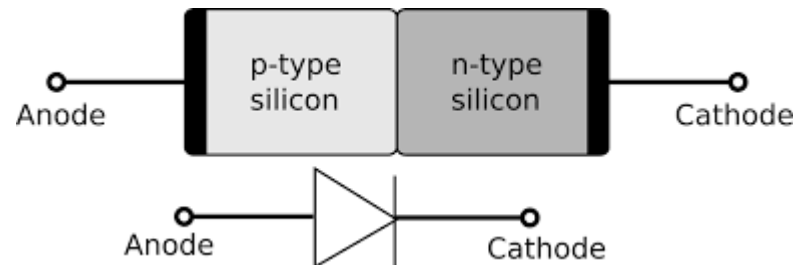
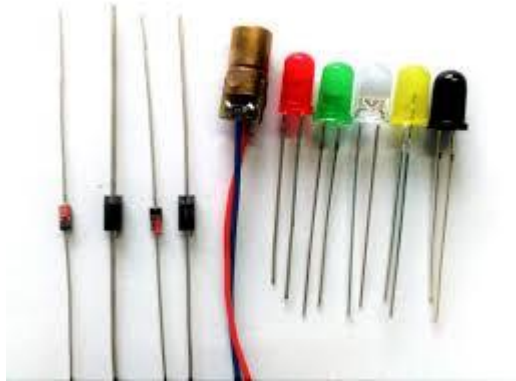


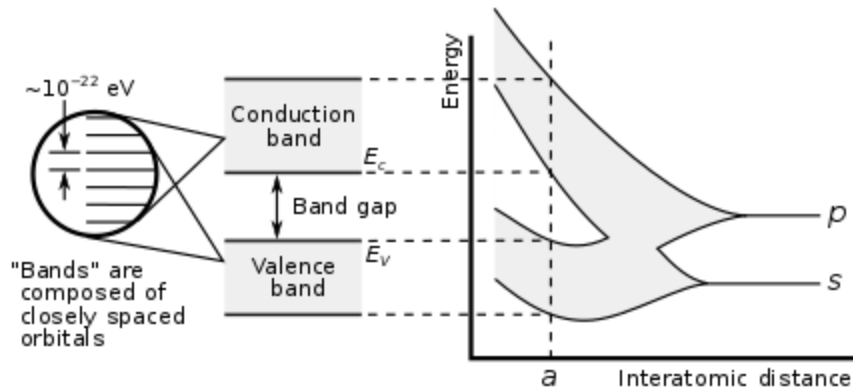
The image displays a portion of the periodic table, highlighting the elements Boron (B), Carbon (C), Nitrogen (N), Oxygen (O), Fluorine (F), and Neon (Ne) in the top row. Below this, the elements Aluminum (Al), Silicon (Si), Phosphorus (P), Sulfur (S), Chlorine (Cl), and Argon (Ar) are shown. The elements Gallium (Ga), Germanium (Ge), Arsenic (As), Selenium (Se), Bromine (Br), and Krypton (Kr) are also visible. The elements Indium (In), Tin (Sn), Antimony (Sb), Tellurium (Te), Iodine (I), and Xenon (Xe) are shown in the next row. The elements Thallium (Tl), Lead (Pb), Bismuth (Bi), Polonium (Po), Astatine (At), and Radon (Rn) are shown in the final row. The elements Lanthanum (La) through Lutetium (Lu) are shown in the bottom row, and the elements Actinium (Ac) through Lawrencium (Lr) are shown in the bottom-most row. The silicon wafer and chip are shown in the background, illustrating the practical application of silicon in technology.

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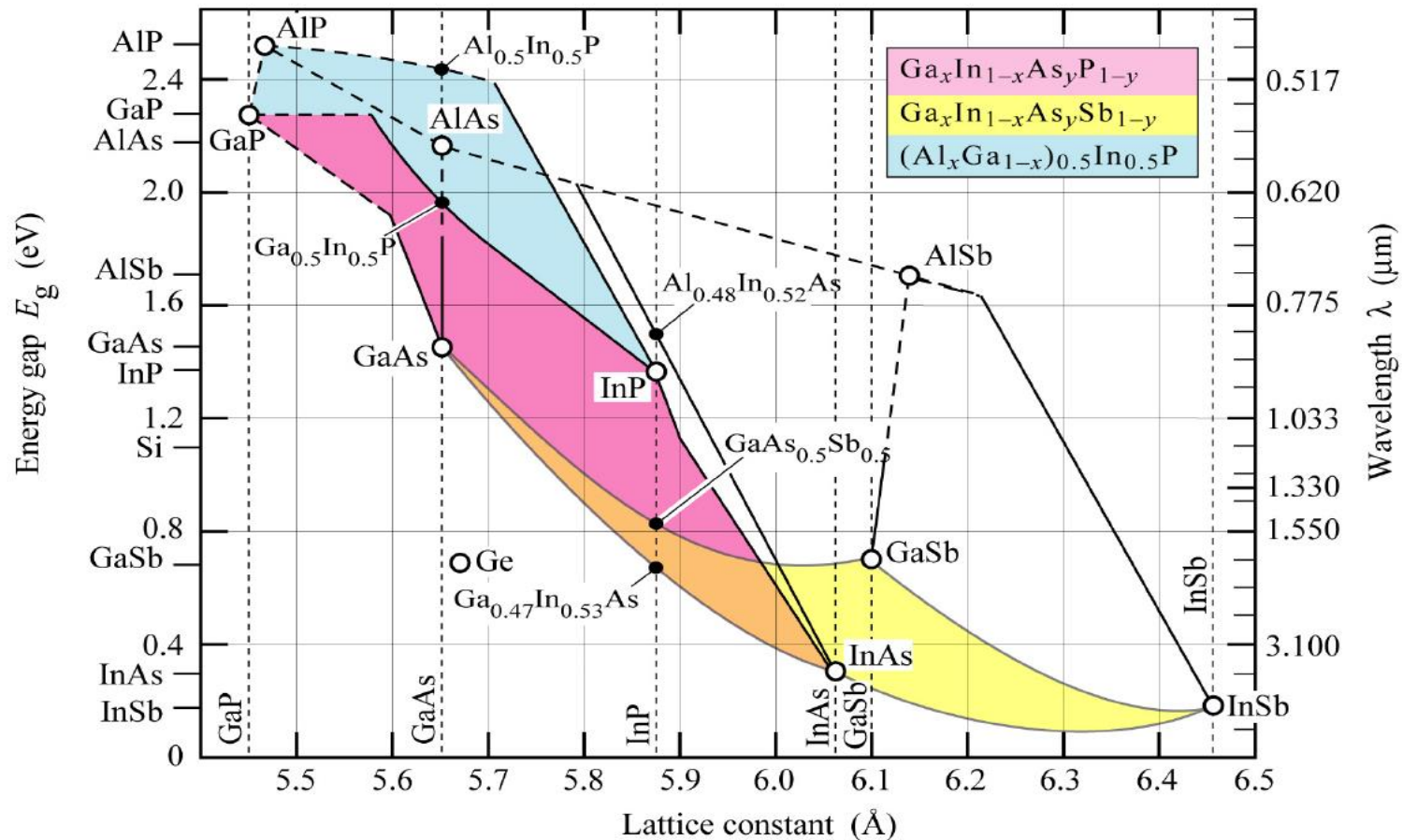
2-Terminal = junctions/diodes: solar cells, LED, lasers...

3-Terminal = transistors (FET, BJT), triggers (SCR, triac)





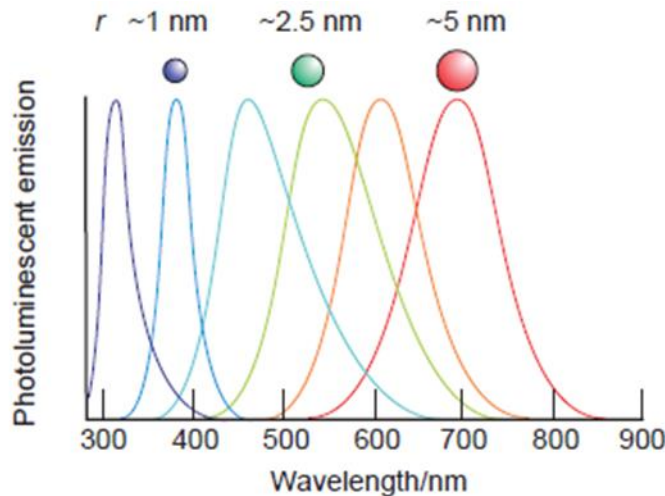
$$E_\gamma = h\nu = \frac{hc}{\lambda}$$



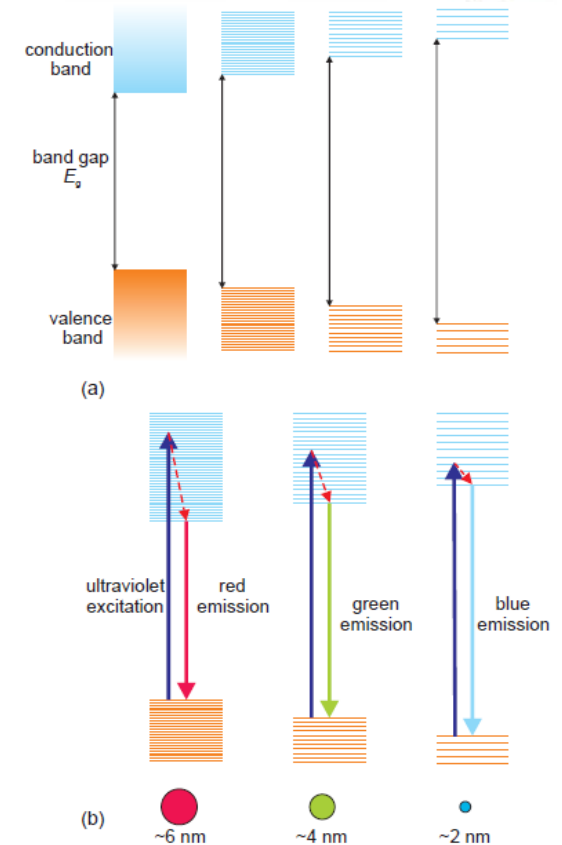
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for nanostructures:  
energy gap ( $E_G$ ) also depends on size

$$E_\gamma = h\nu = \frac{hc}{\lambda}$$



**Figure 14.40** Photoluminescent colours emitted by CdS quantum dots.

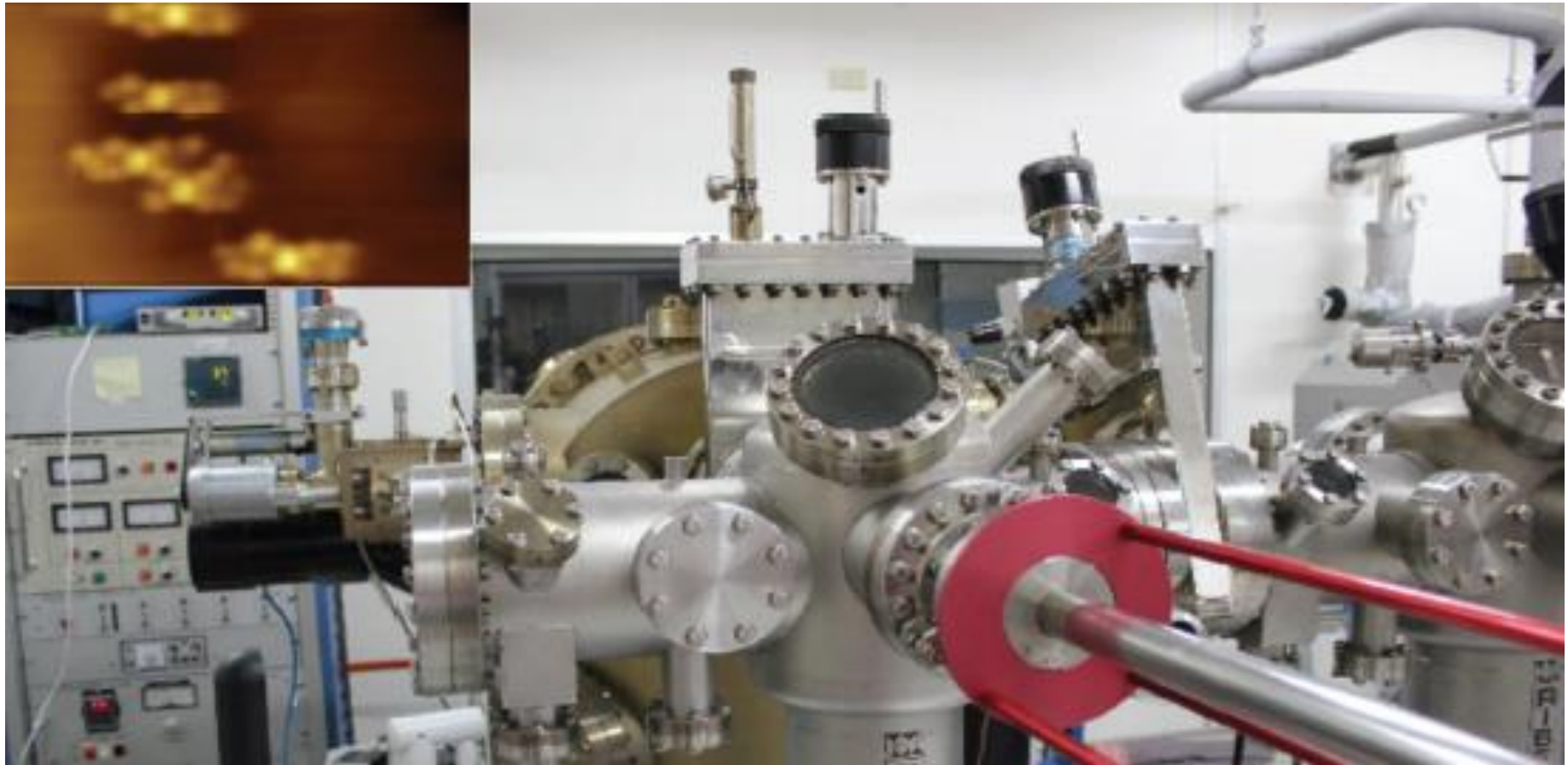


**Figure 14.41** Quantum dot colours: (a) the change in band structure of a quantum dot as the diameter falls; (b) fluorescence colours of different diameter dots



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Molecular Beam Epitaxy (MBE) enables crystal growth with subatomic layer precision



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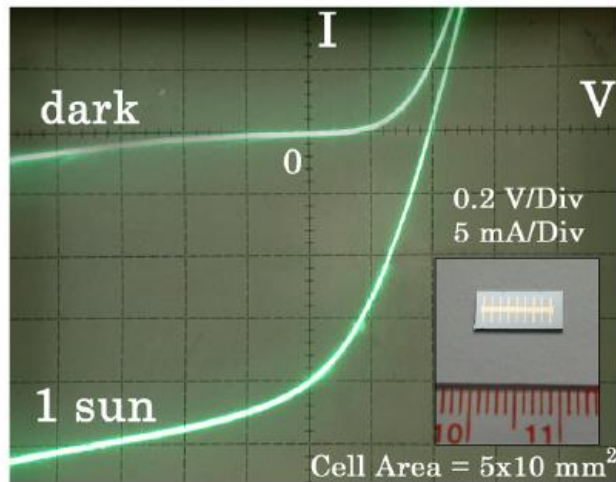
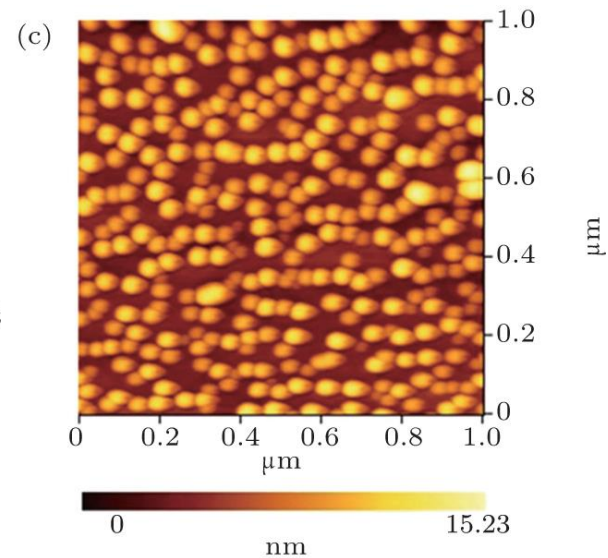
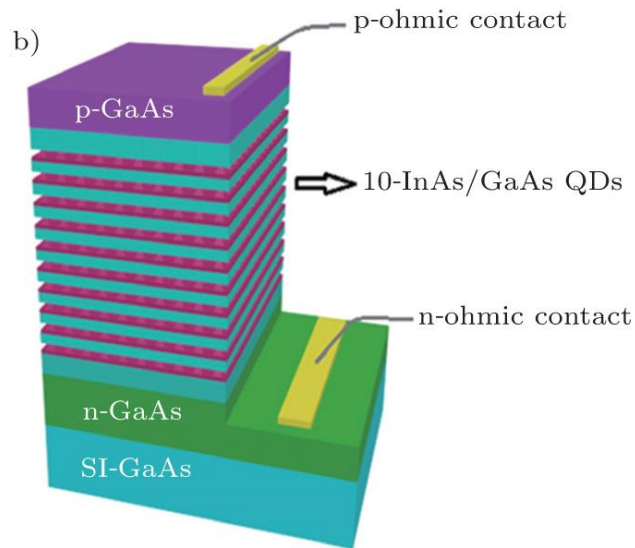


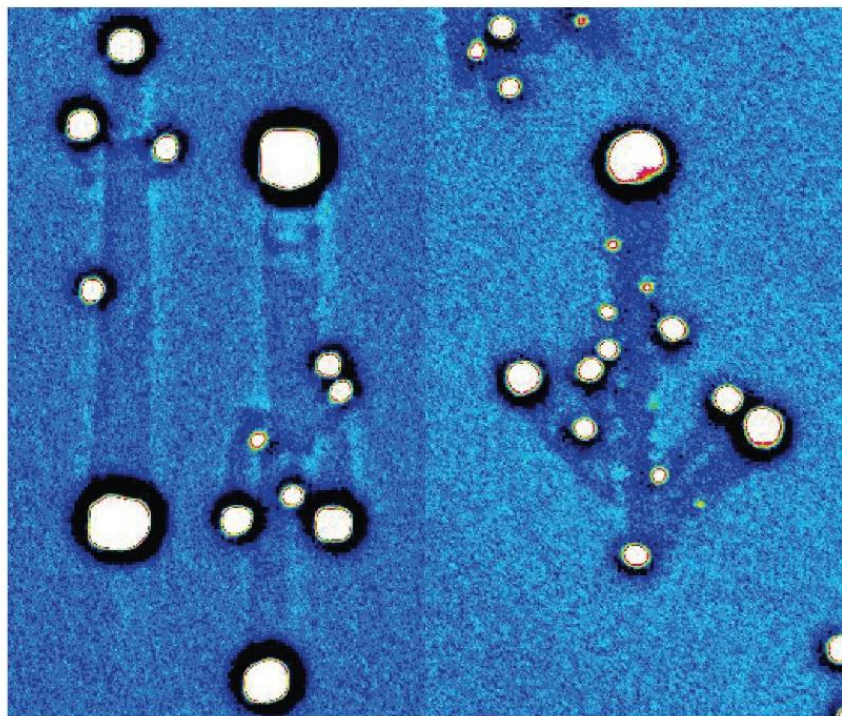
Fig. 5. *I-V* characteristics of 3-stack, high-density QDM solar cell showing a possibility to deliver short-circuit current density as high as 40 mA/cm<sup>2</sup> (the inset shows the photo of the cell with area of 5 × 10 mm<sup>2</sup>).



# CRYSTAL GROWTH & DESIGN

February 2014  
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INTEGRATING THE  
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ENGINEERING AND  
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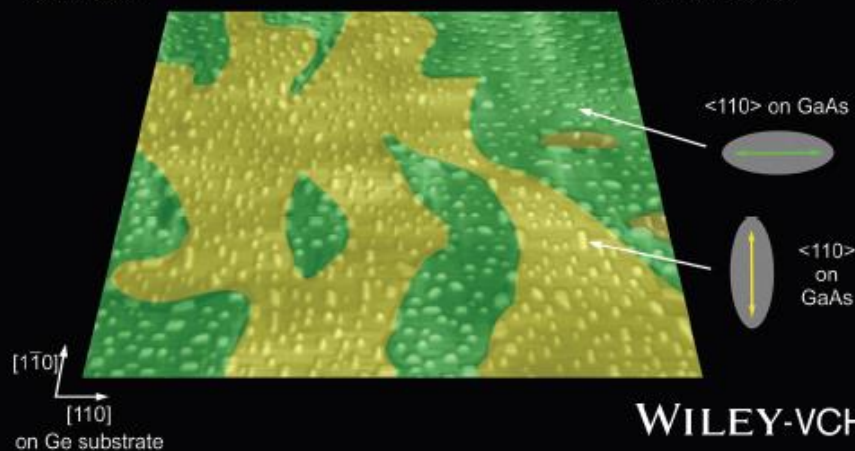
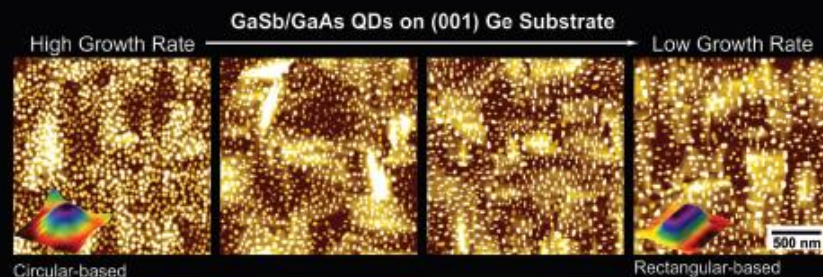
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