



Photoluminescence of 2D-vertical In-rich APBs embedded in InGaP/SiGe/Si

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Photoluminescence of 2D-vertical In-rich APBs embedded in InGaP/SiGe/Si

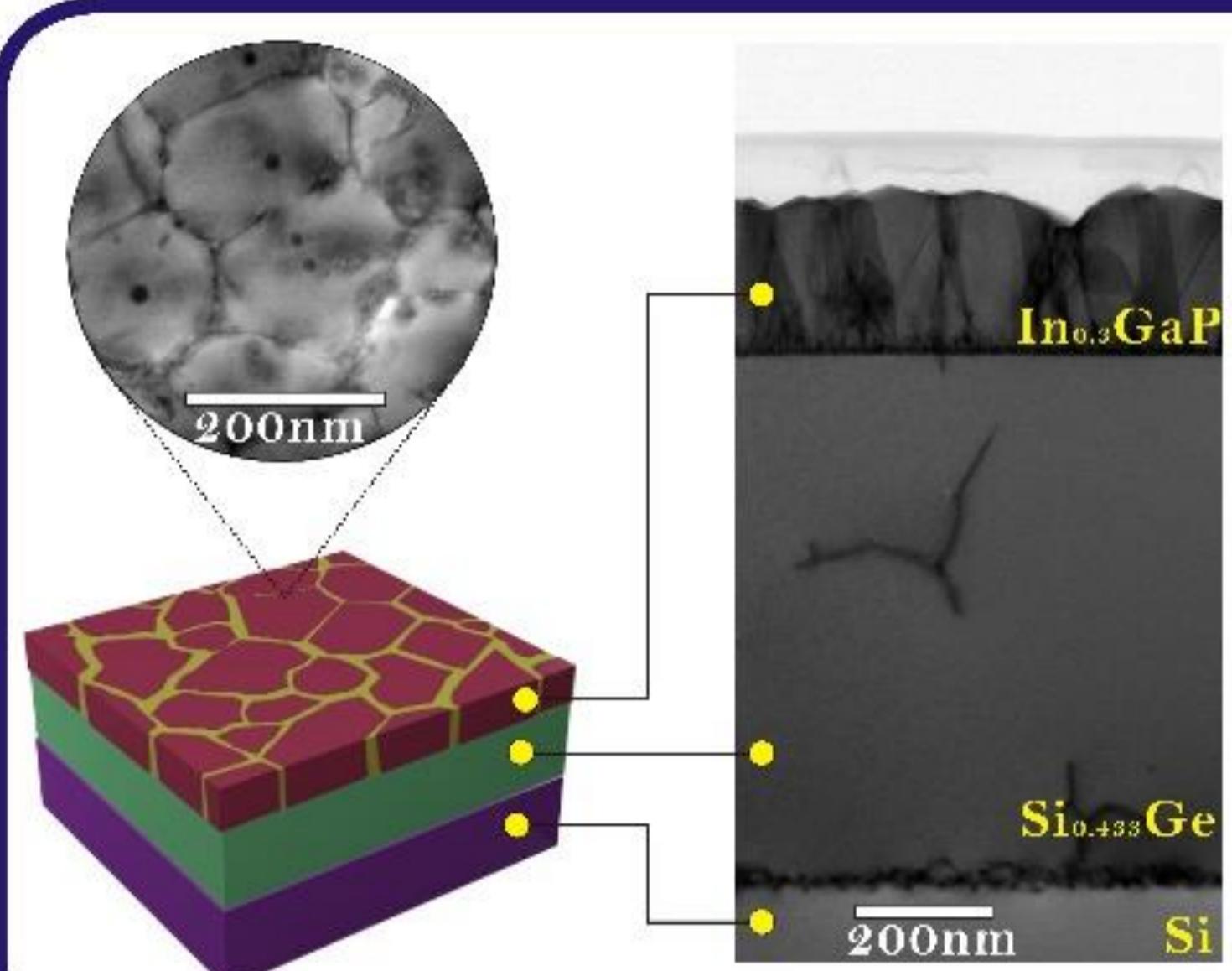
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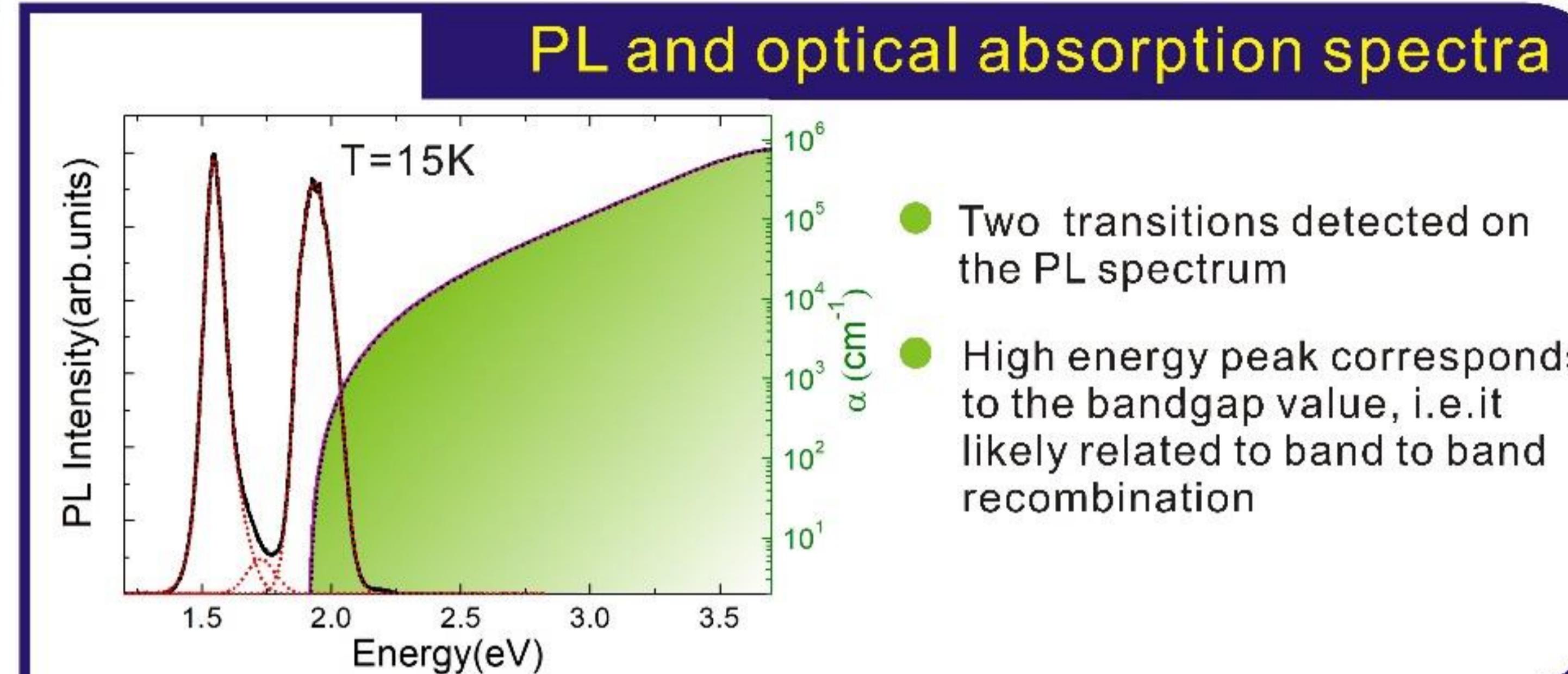
Introduction

Heterogeneous epitaxy of III-V compounds with superior optical properties onto Si substrate very close to the III-V/Si hetero-interface becomes major concern for Si photonics. Antiphase boundaries(APB) are generated during heteroepitaxy, have always been considered as detrimental defects for optical devices. However, in this work we provided a new insight into the APBs which are involved in an efficient luminescence process.

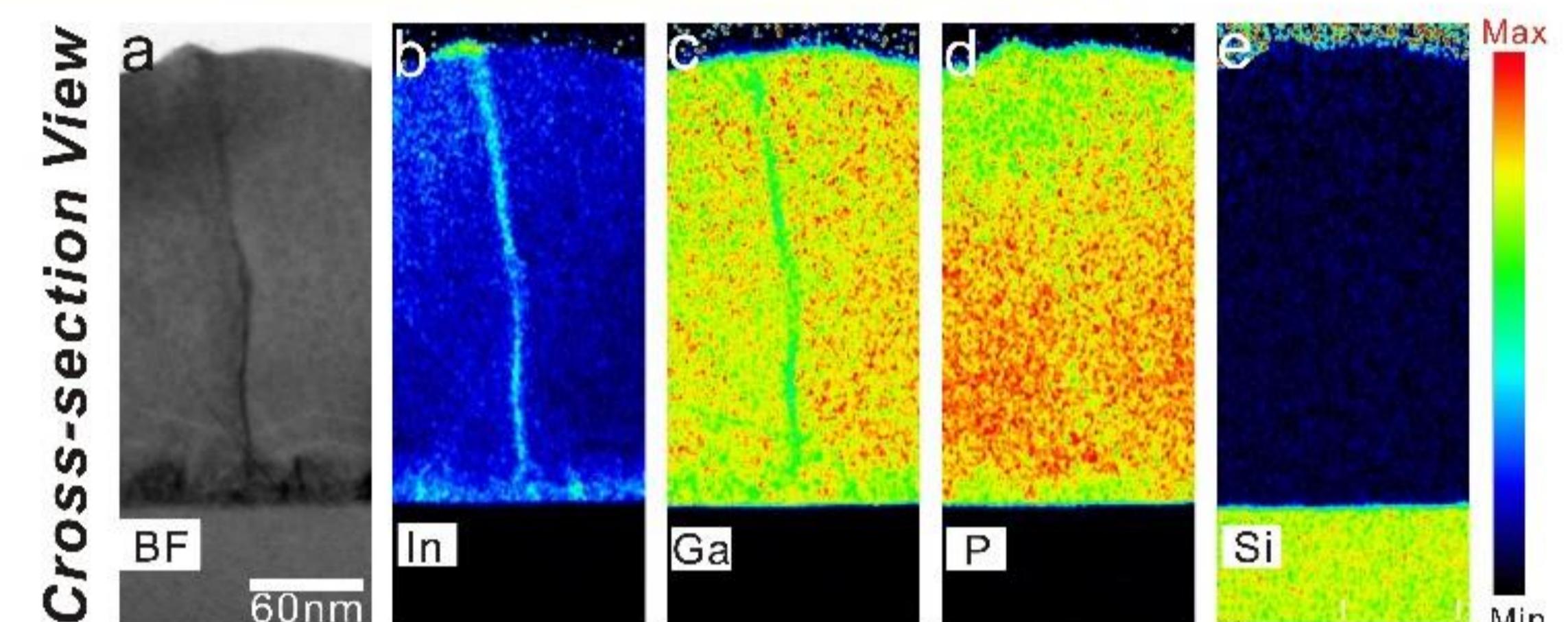


TEM micrographs

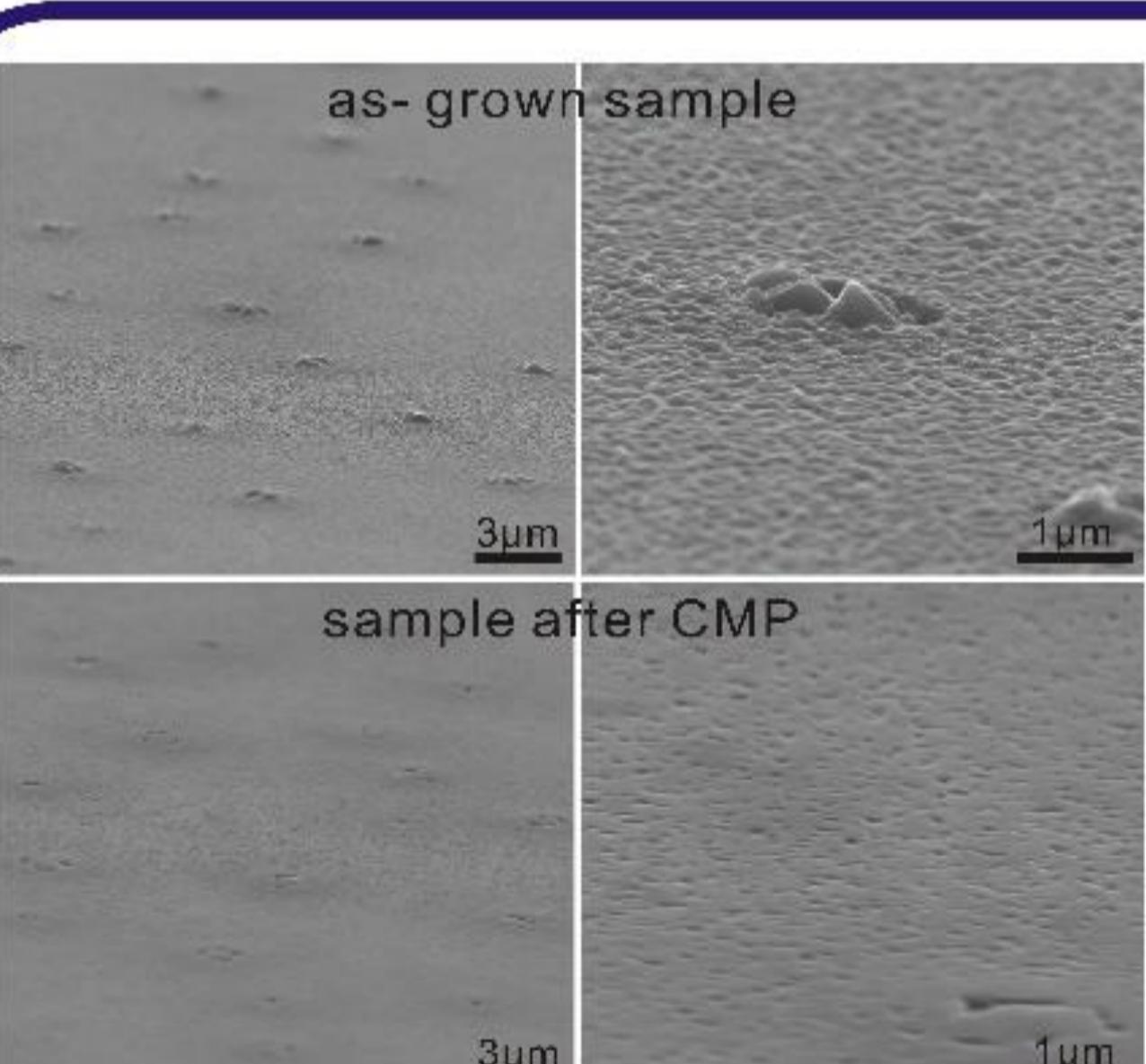
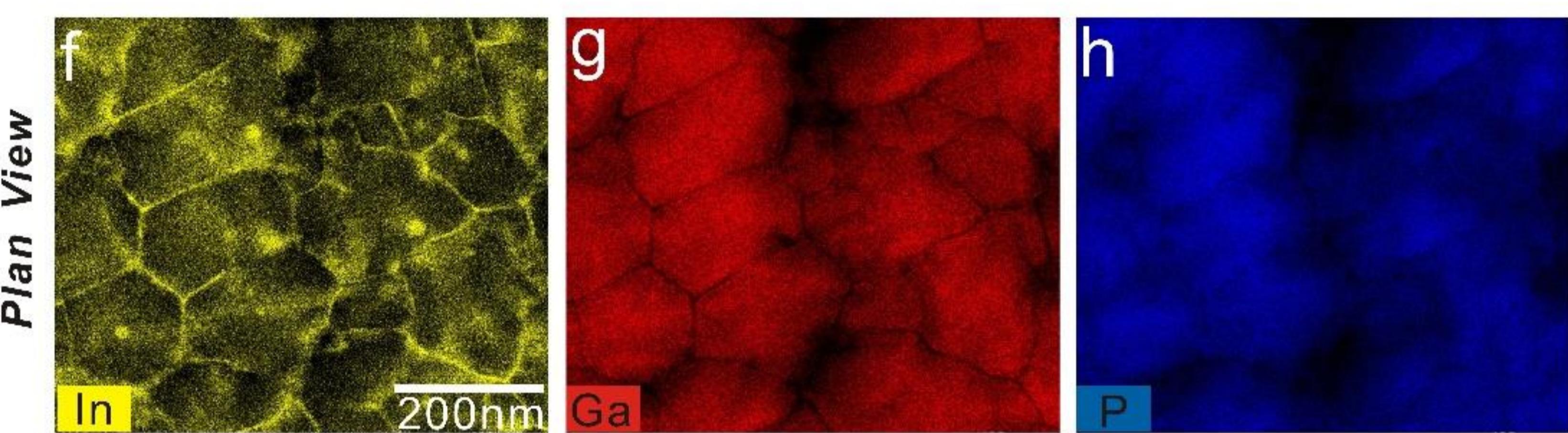
- InGaP active layer contains many antiphase boundaries (APBs)
- Some quantum dots(QDs) observed on the surface



EDX elemental mapping



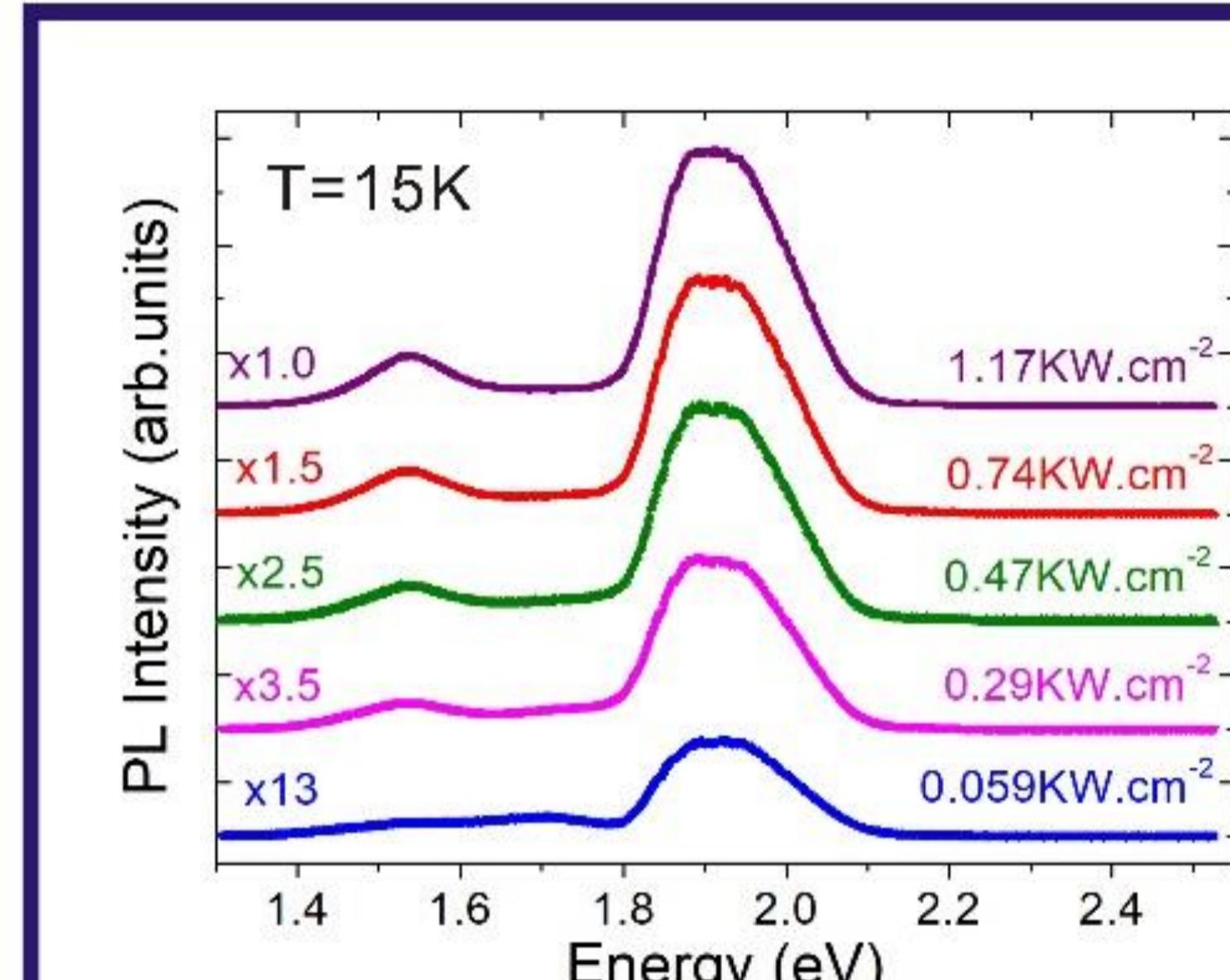
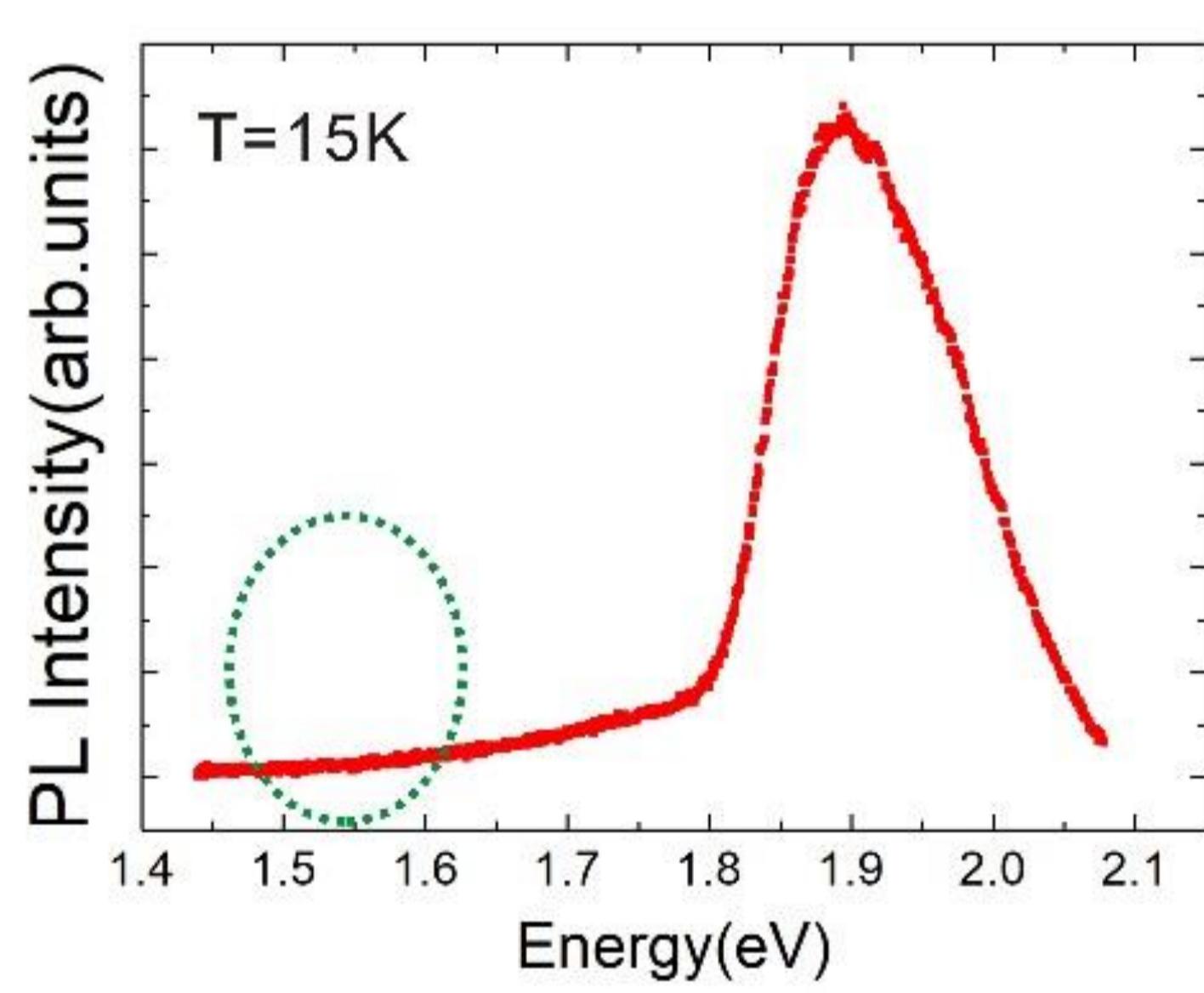
- Two kinds of nanostructures: pure InP surface QDs and In-rich APBs



Sample after CMP

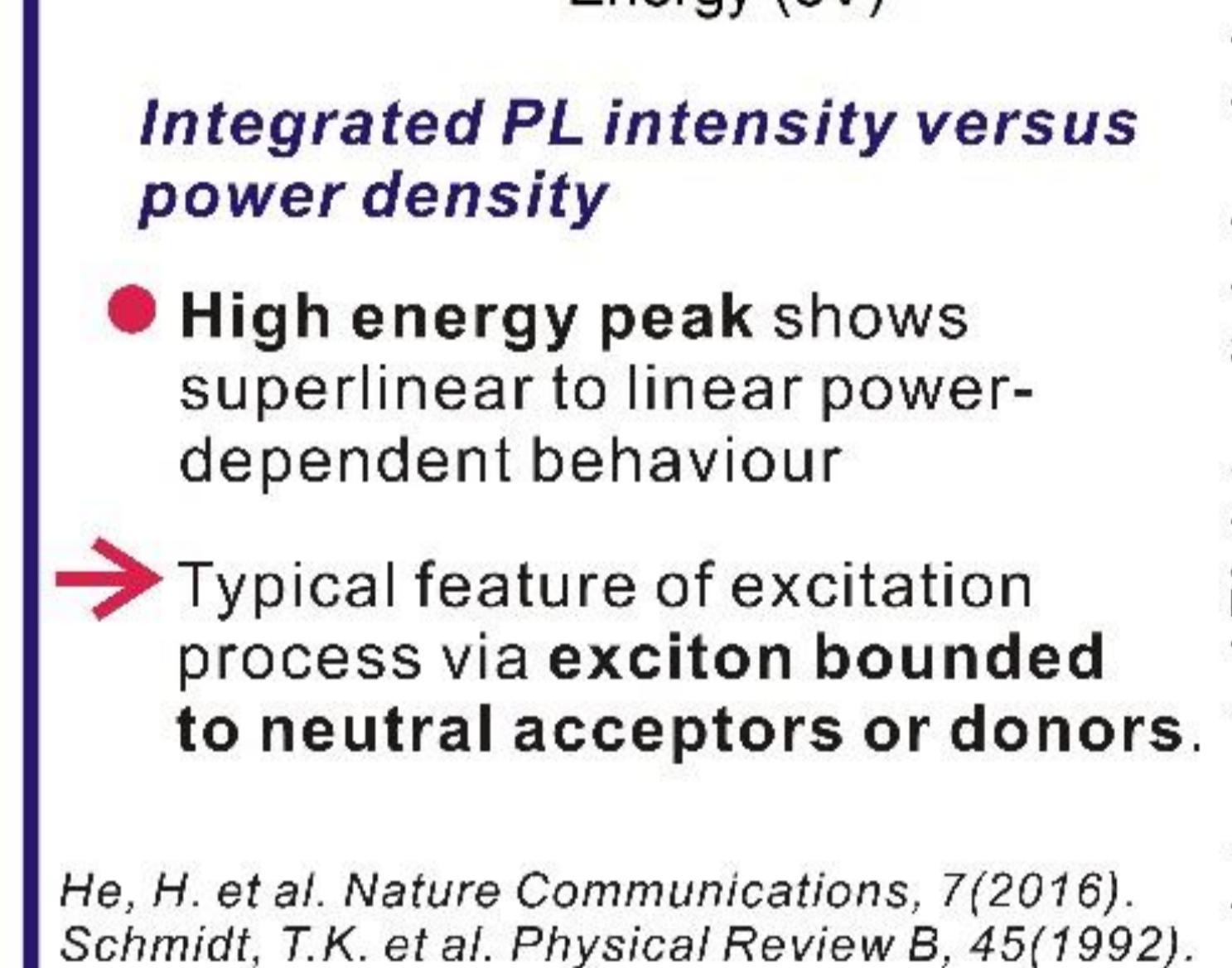
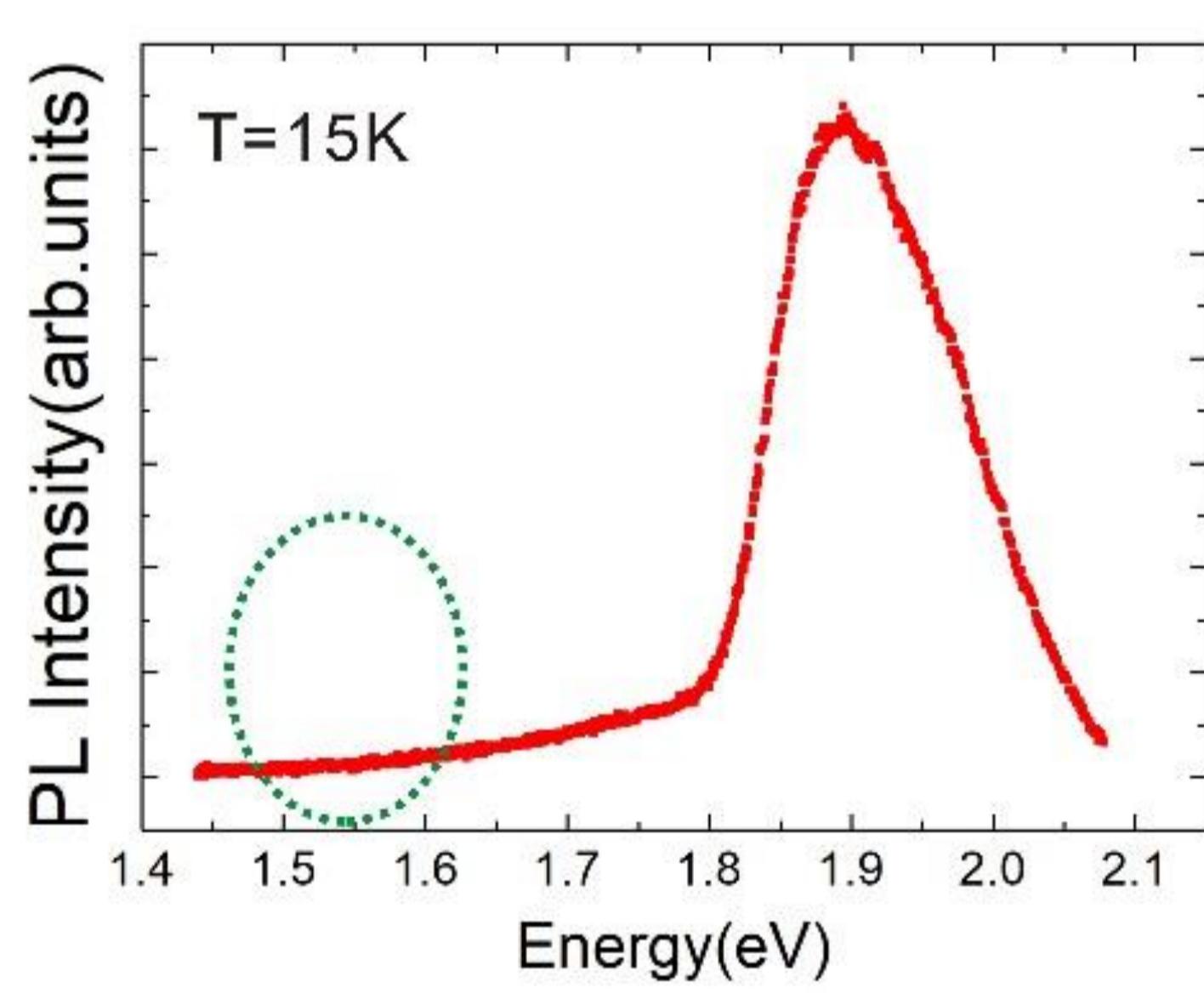
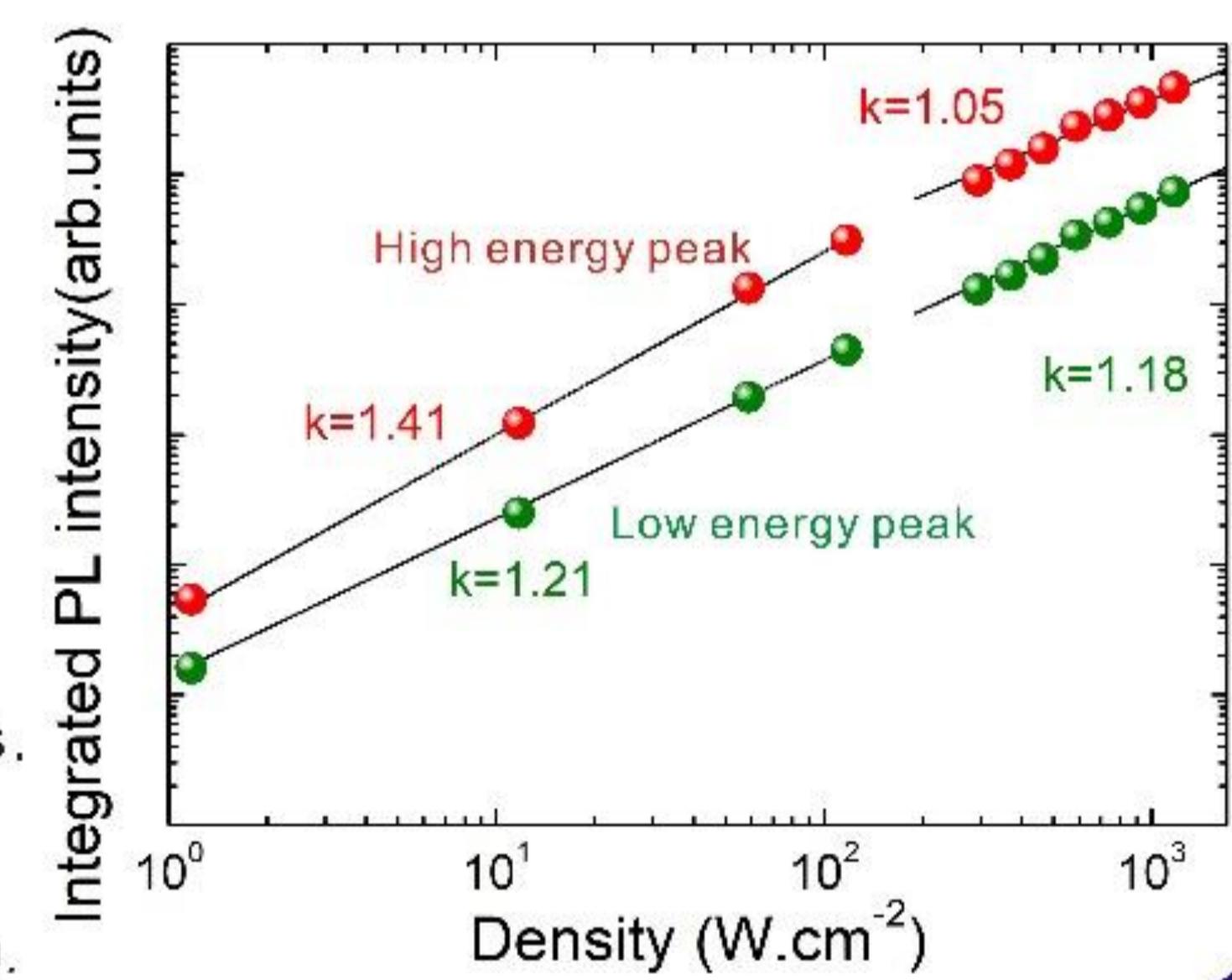
SEM images of as-grown sample and sample after chemical mechanical polishing(CMP)

- Surface QDs are almost removed after CMP



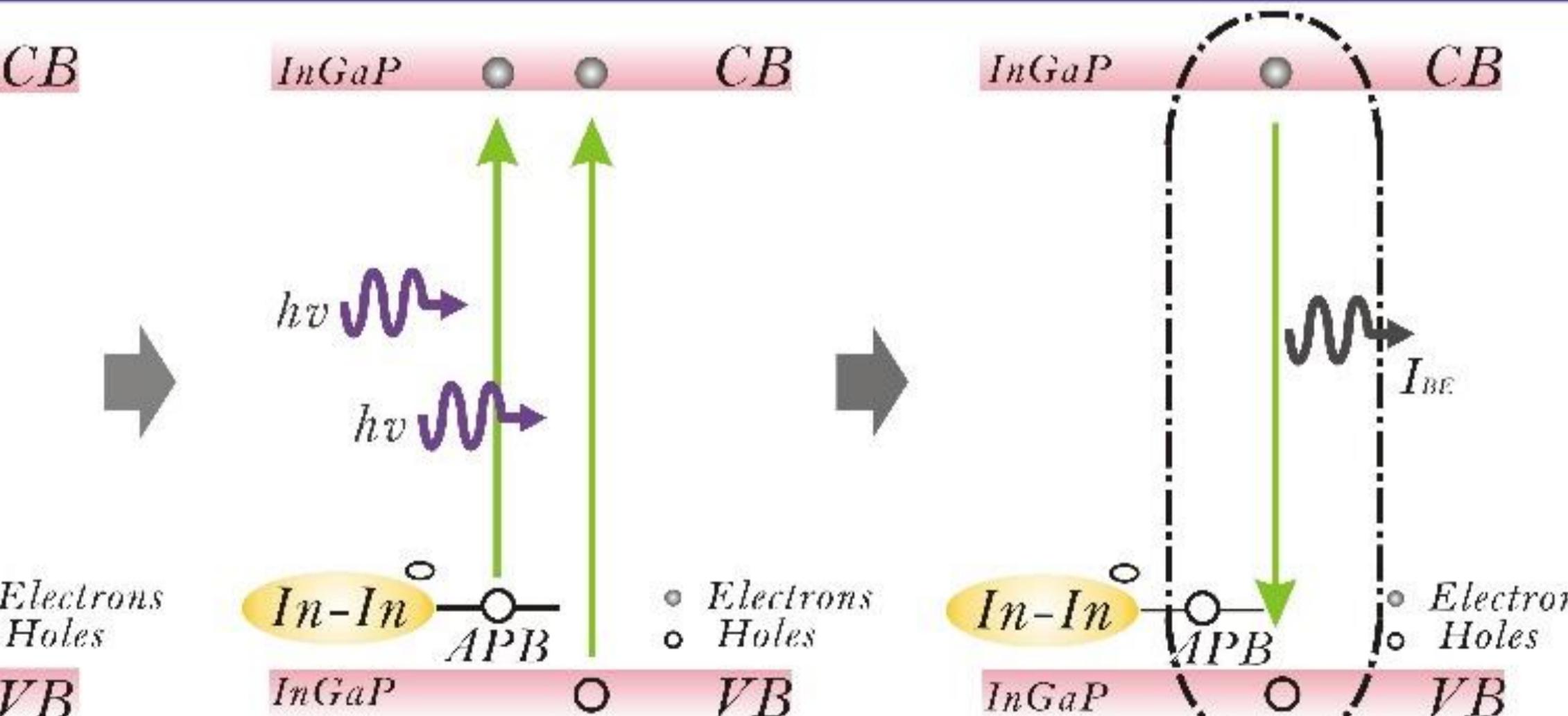
Power-dependent PL

Steady-state PL with saturated InP QDs



He, H. et al. *Nature Communications*, 7(2016).
Schmidt, T.K. et al. *Physical Review B*, 45(1992).

InGaP
Before irradiation



Physical mechanism proposed for the high energy PL peak

- In APB spacing, many acceptor-like states shown due to III-III bonds in the band gap
- Excitons bounded to neutral APBs

Tea, E. et al. *Journal of Applied Physics*, 115(2014).

Conclusions

- Preferential incorporation of In atoms on APBs is evidenced.
- Low energy peak is proved to come from the surface InP QDs.
- High energy peak results from localized excitons bounded around the neutralized In-rich APBs.