Polariton with high quality factor in a hybrid ZnO-based microcavity

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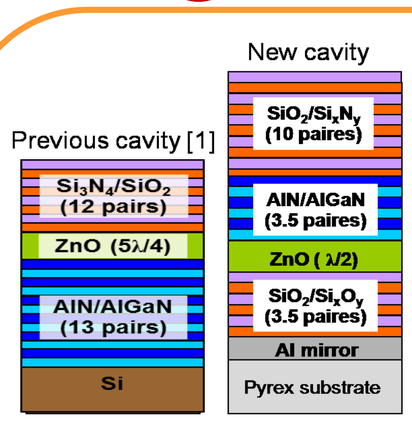
ZnO based microcavities are exhibiting very well defined excitonic features with a large ratio of the vacuum Rabi splitting to the polariton linewidth, and a large exciton binding energy which make them suitable for room temperature polariton lasers. However, a main drawback in order to obtain cavities with high Quality factor (Q) values is the intense strain in AlGaN/AlN DBRs limiting the ability of growing large number of AlGaN/AlN pairs. Here, we propose an alternative way for achieving high Q values by introducing a new hybrid-type ZnO-based planar microcavity. Compared to other reported oxide cavities, the good crystal quality of the active layer can be achieved by growing the ZnO on top of AlN. We explore the microcavity by performing μ-Photoluminescence (μ-PL) and μ-Reflectivity experiments mapping in micron scale the polariton branch on the sample surface.

New process for larger Q values

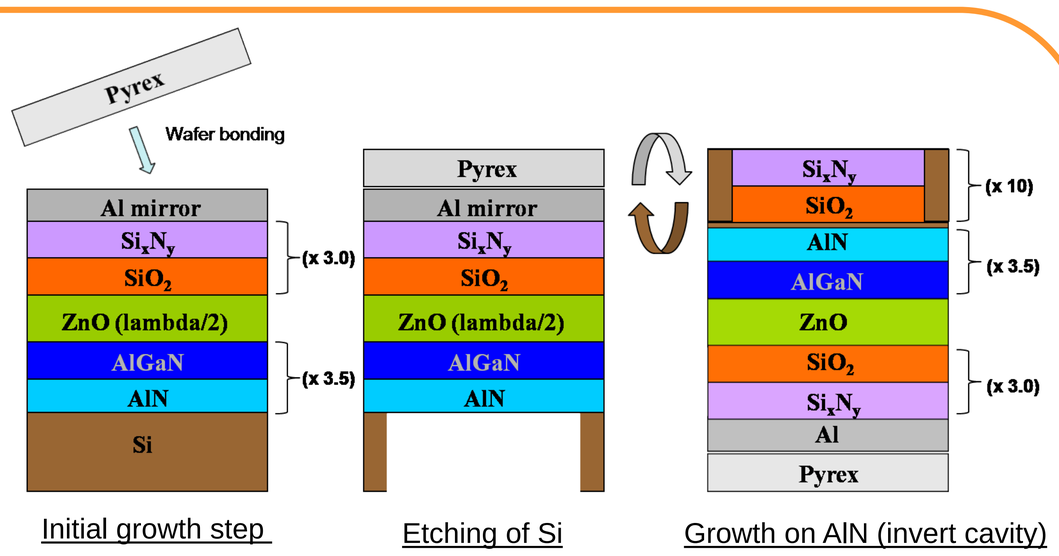


Quality factor:

Q~450 **Q~675**

Theory :

Q~600 **Q~900**



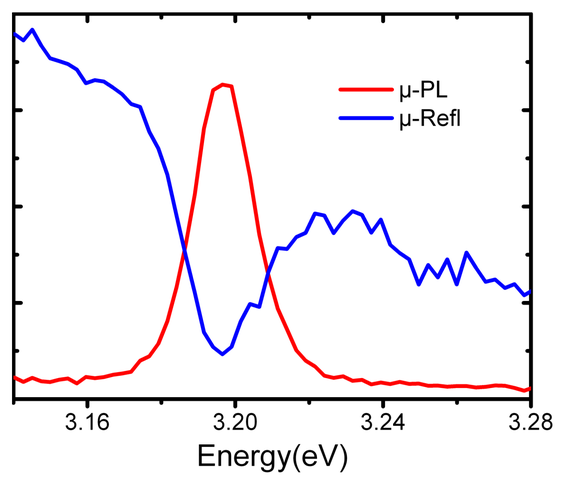
- **MBE Nitride mirror**
  E. Frayssinet (CRHEA)
- **Deposition of ZnO**
  J. Zùñiga-Pérez (CRHEA)
- **RF-PECVD $SiO2/Si_XN_Y$**
  S. Bouchoule (LPN)

[1] S. Faure *et.al.*, Appl. Phys. Lett. 92, 121102 (2009)

& T. Guillet *et.al.*, Appl. Phys. Lett. 98, 211105 (2011)

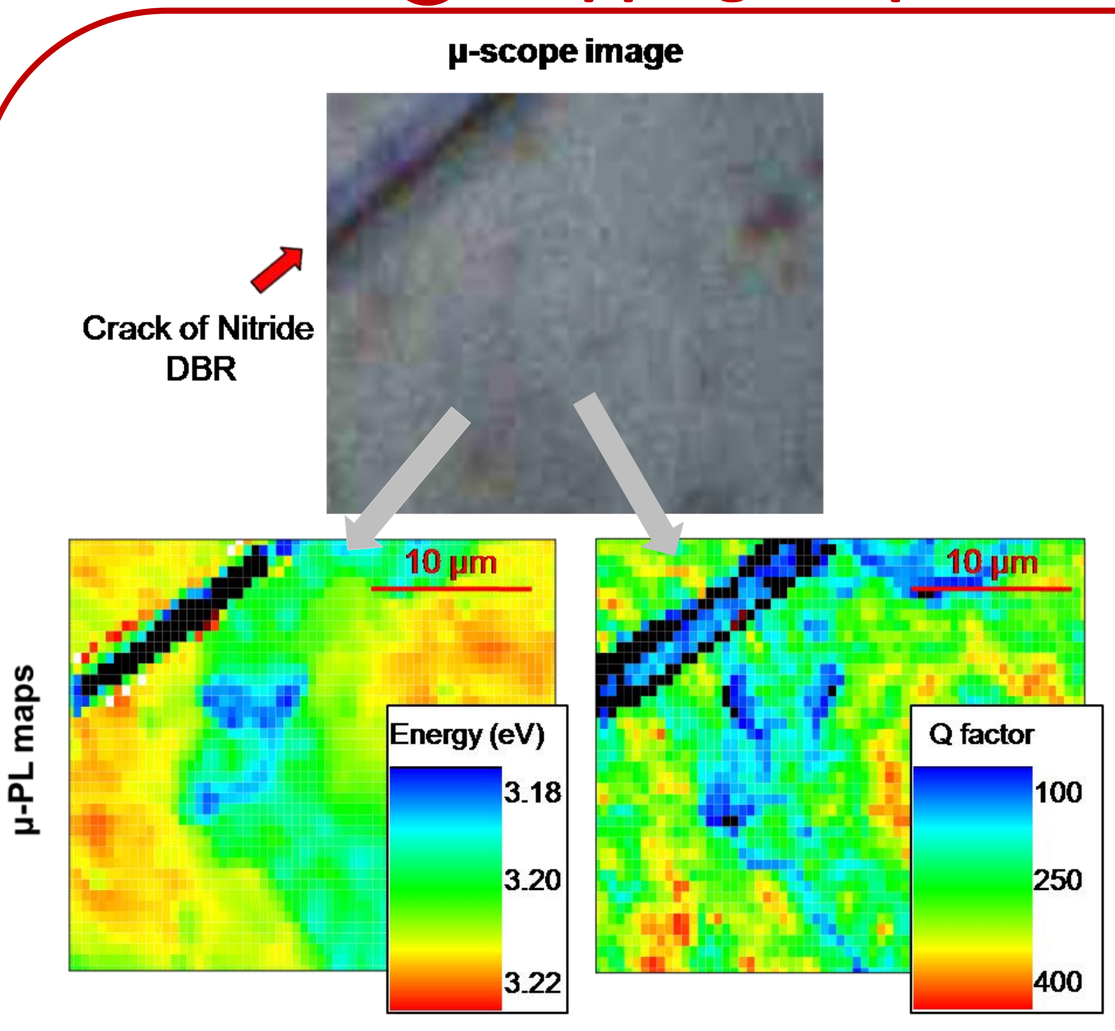
Reflectivity & PL

μ- Photoluminescence & μ-Reflectivity at 300K



- **μ-PL and μ-reflectivity spectra show the low branch polariton around ~3.20eV**

Mapping the polariton disorder

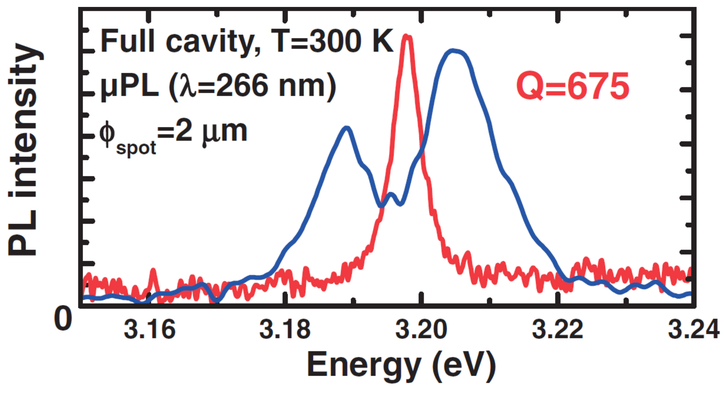


Explored Area: 20x30 μm²

300K / CW laser at 266nm, spot size ~1μm

μ-PL maps of polaritonic energy peak and Q factor

- **Spatial inhomogeneity due to thickness fluctuation (active region and DBR)**
- **Additional thickness fluctuations due to incomplete removal of Si substrate**
- **Locally polariton modes with high Q factor (up to ~675)**
- **Maps of μ-reflectivity shows similar behavior**



L. Orosz *et.al.*, Appl. Phys. Express 4, 072001 (2011)

Conclusions

- **High Q values (up to 675) with a new process of hybrid-type ZnO microcavities**
- **Better cristalline quality of the ZnO active layer compared to fully oxide cavities but**
- **Polaritonic disorder at the micron scale related to thickness fluctuations and the removal of the Si substrate**

Perspectives

- **Need to improve further the fabrication process in order to minimize the spatial inhomogeneity and to obtain higher Q values**

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