



## Characterization of $\beta$ -Ga<sub>2</sub>O<sub>3</sub> and device fabrication

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# Characterization of $\beta$ -Ga<sub>2</sub>O<sub>3</sub>

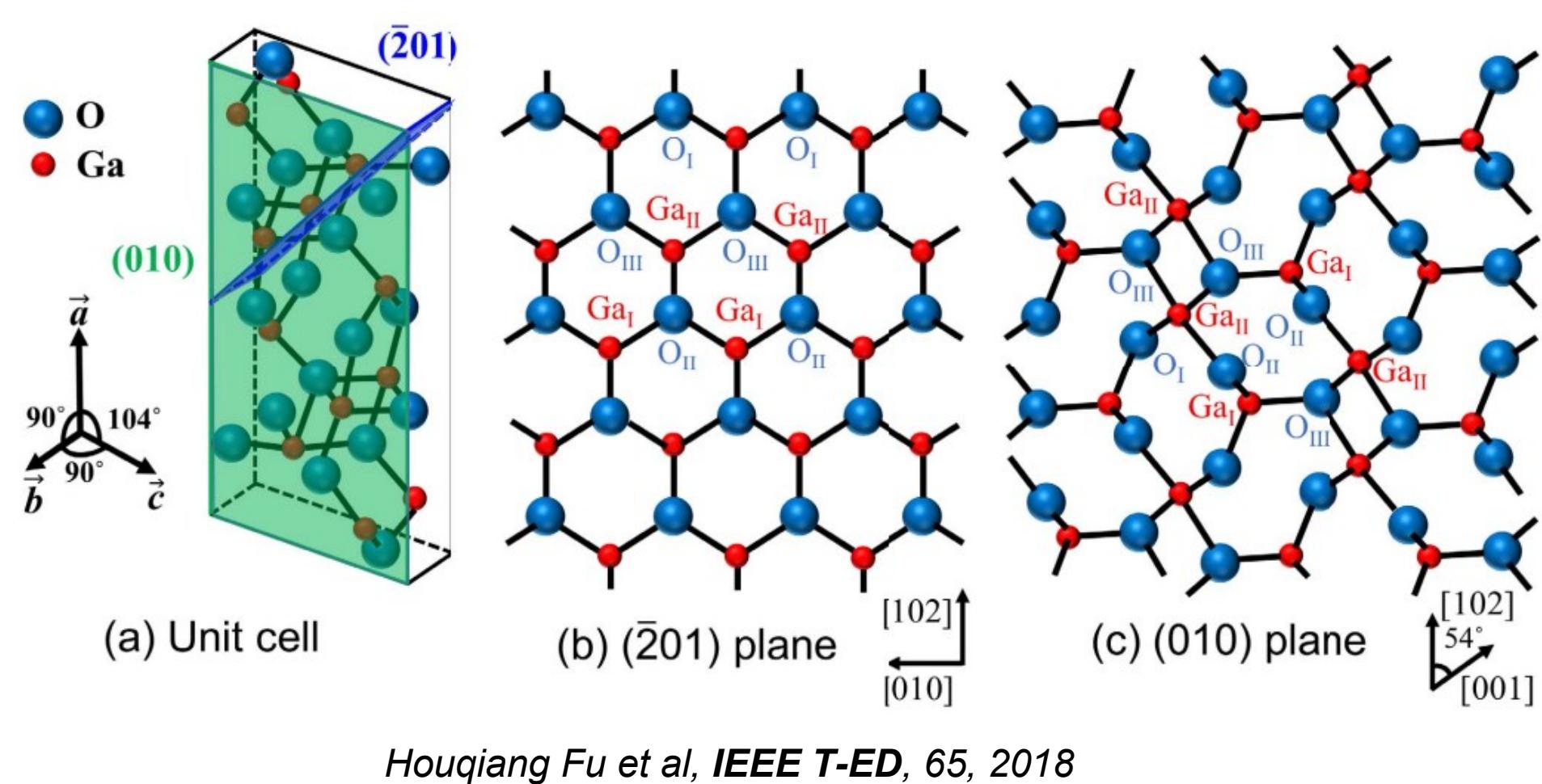
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## Introduction



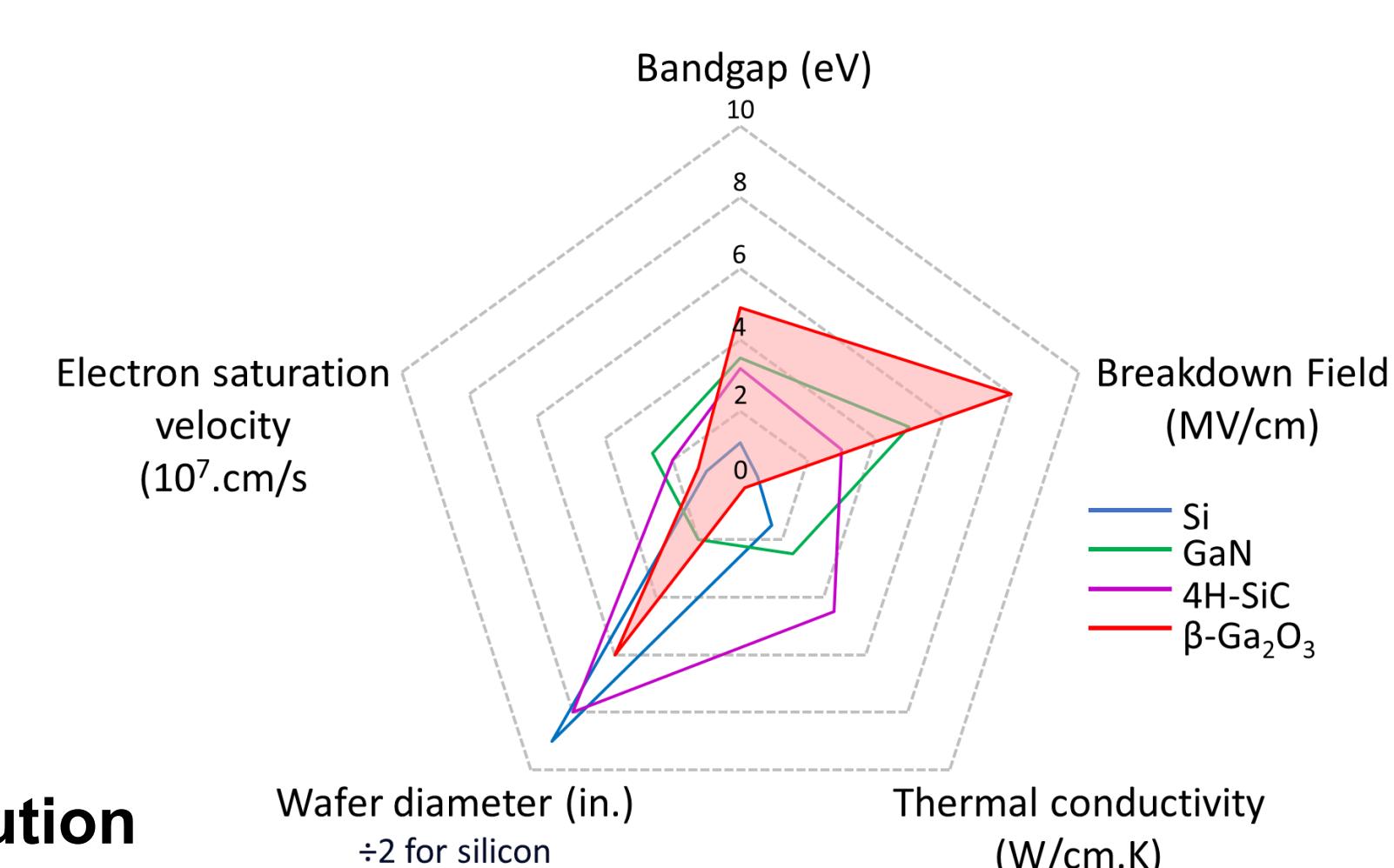
$\beta$ -Ga<sub>2</sub>O<sub>3</sub> : monoclinic lattice  $\rightarrow$  weak symmetry

- Two different cell units : Ga<sub>I</sub>O<sub>4</sub> and Ga<sub>II</sub>O<sub>6</sub>
- Anisotropy of electrical and optical properties
- Applications in power devices and UV photodetectors

**Objectives** : Raman/PL characterization of  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> to better understand the effects of material defects and substrate orientation on  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> power devices electrical performance

➤ Identification of  $\beta$ -Ga<sub>2</sub>O<sub>3</sub>

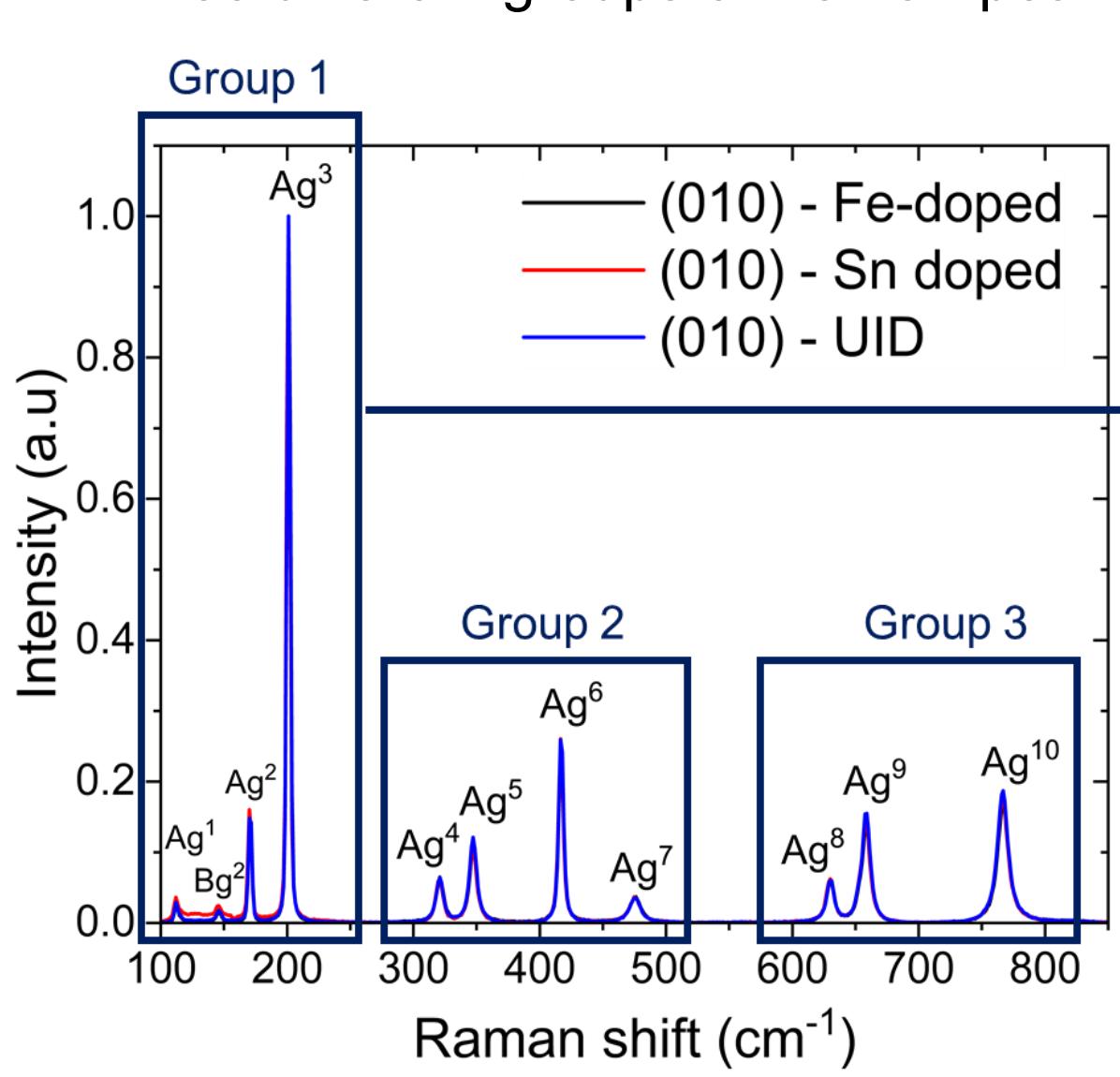
➤ Defect & stress distribution



## Identification of substrates

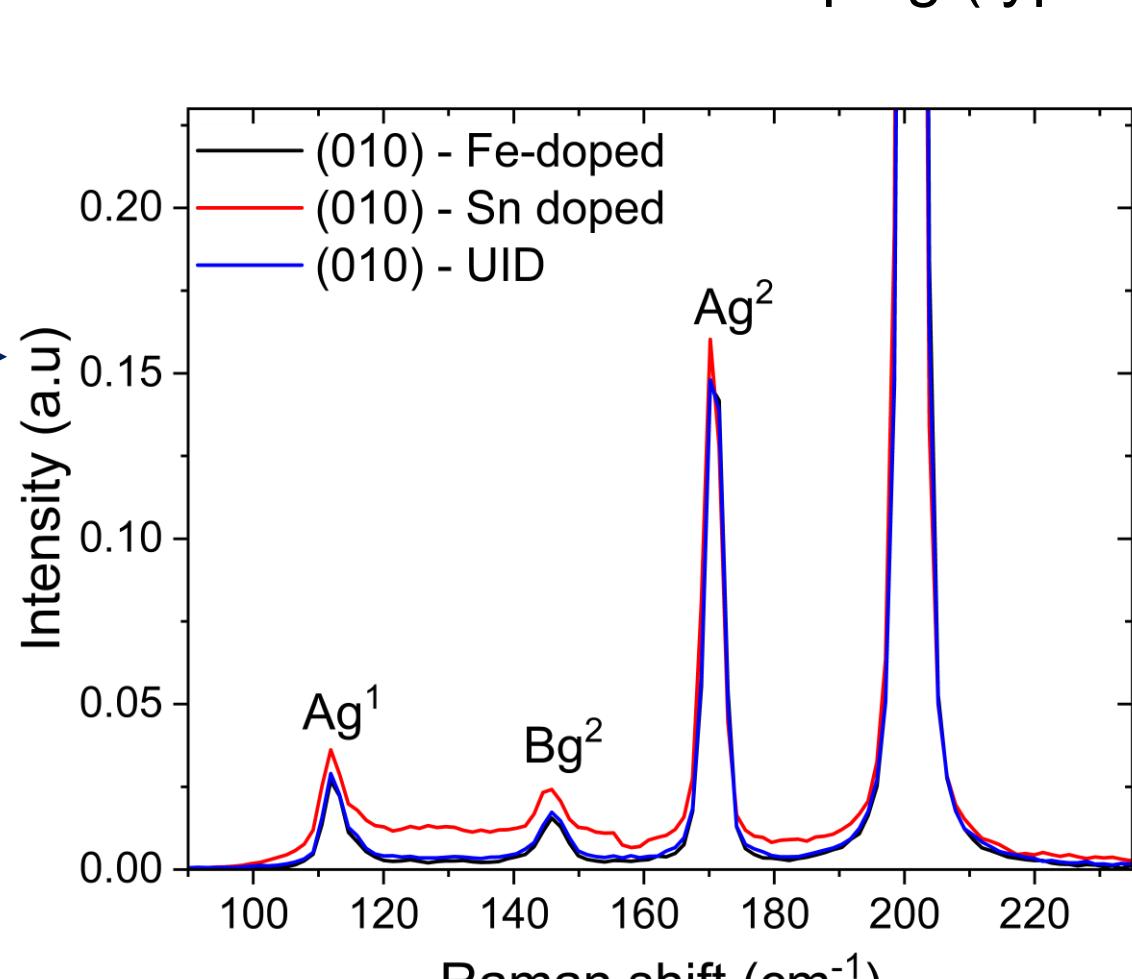


➤ Three different groups of Raman peaks

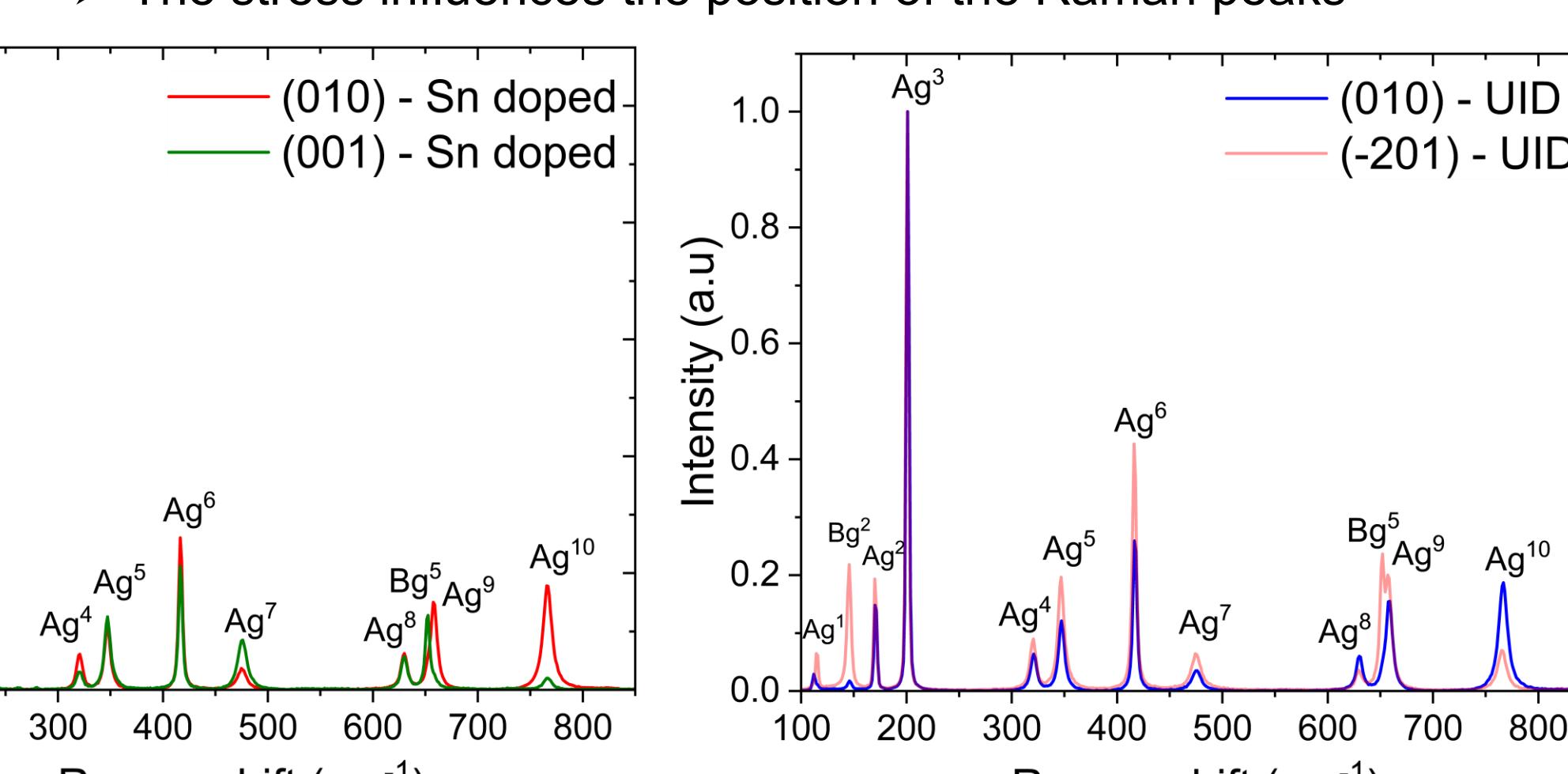


Raman spectra of  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> substrates with green laser

➤ Low influence of doping on the spectra : small variation for Sn doping (type n)

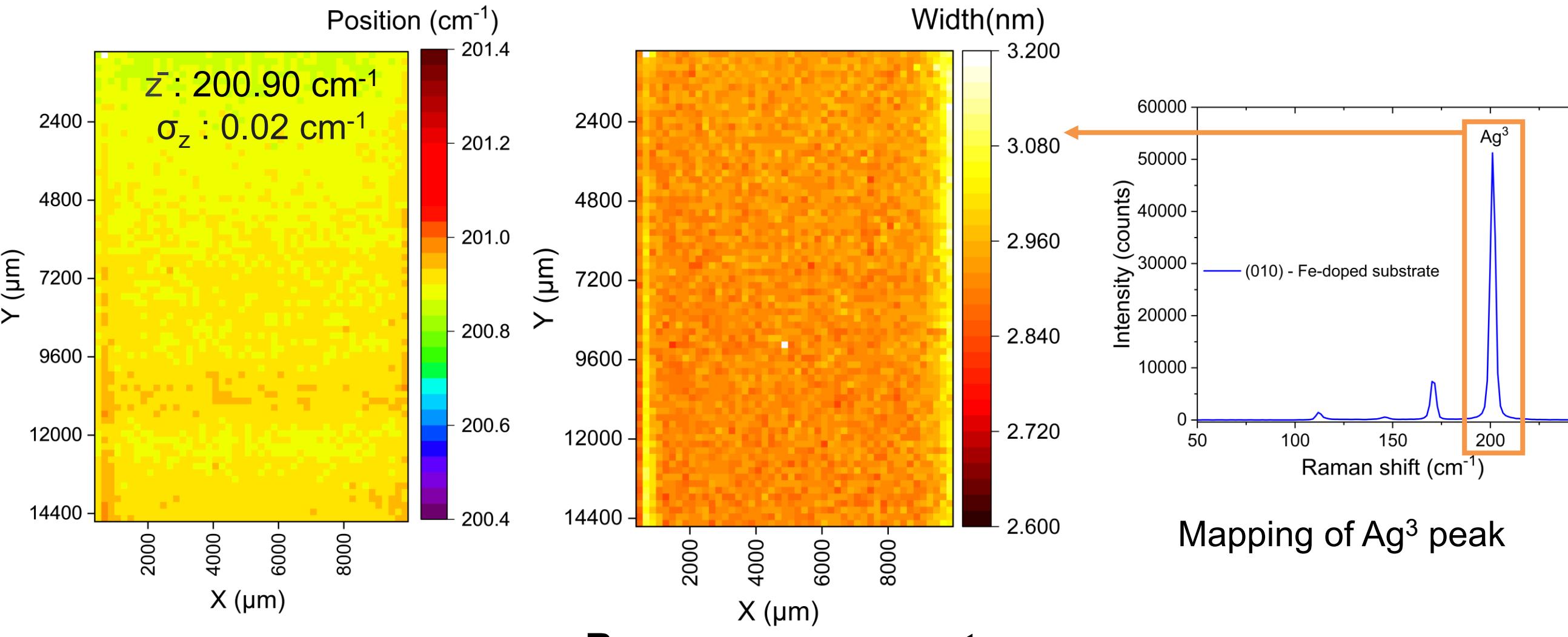


➤ The orientation of the substrate affects the Raman spectra  
➤ The stress influences the position of the Raman peaks



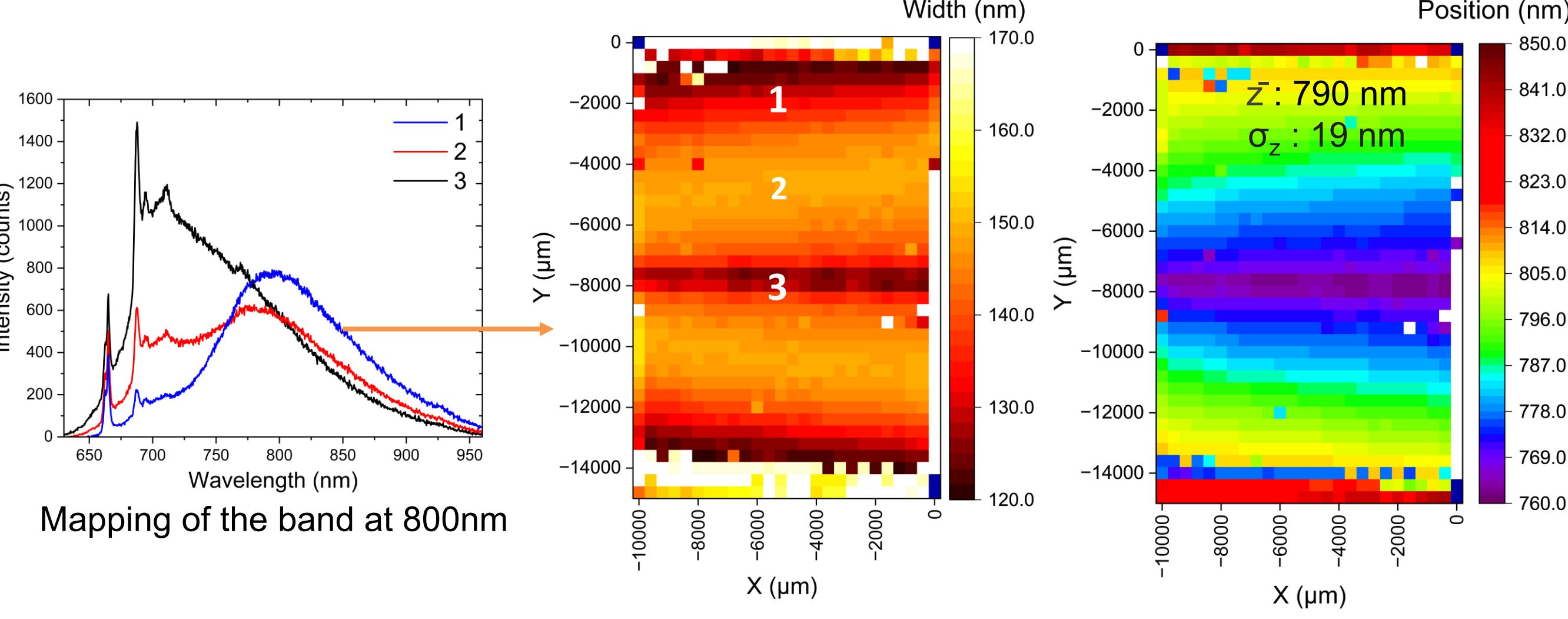
## Defect and stress distribution in substrates

### Raman mappings with green laser

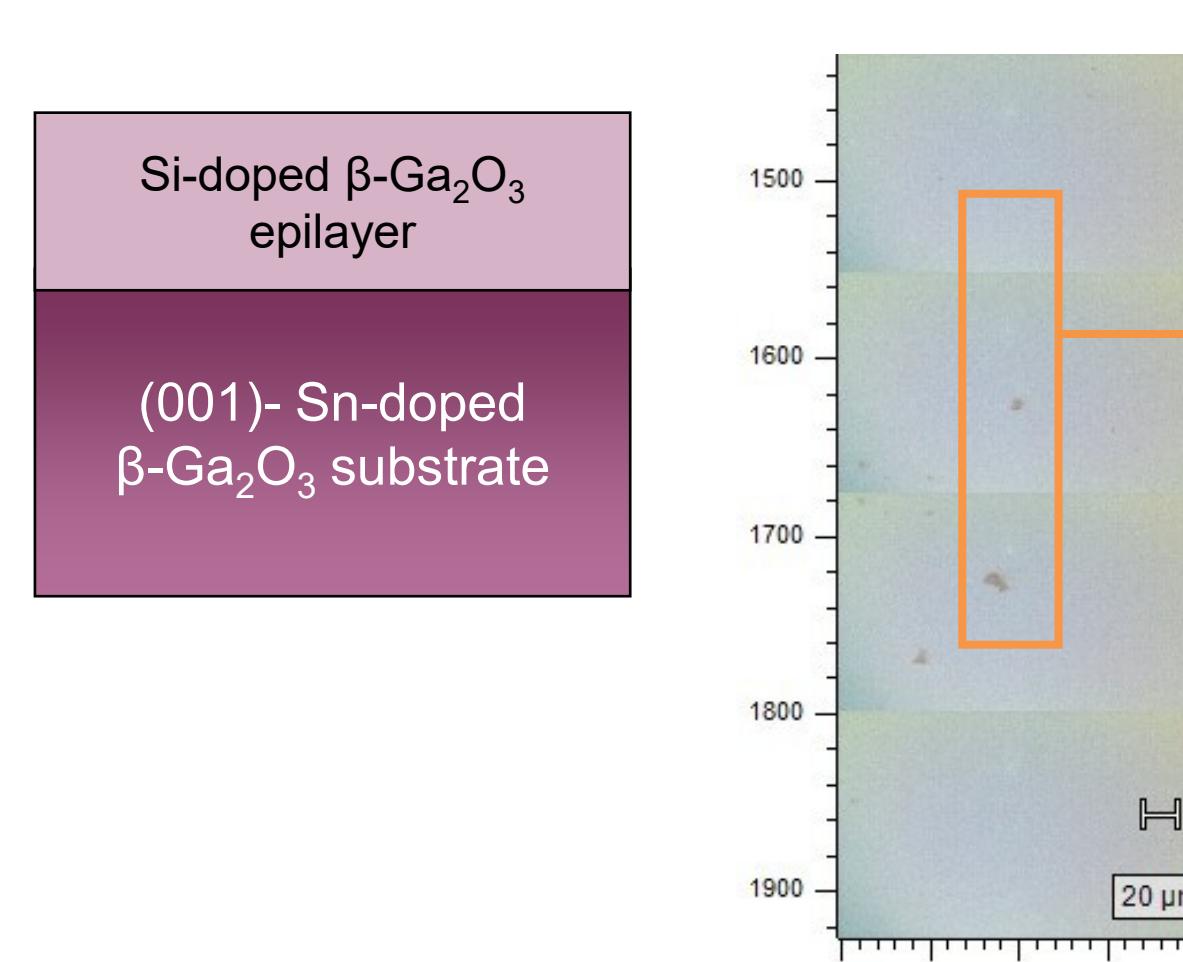


### Fe-doped $\beta$ -Ga<sub>2</sub>O<sub>3</sub> substrate

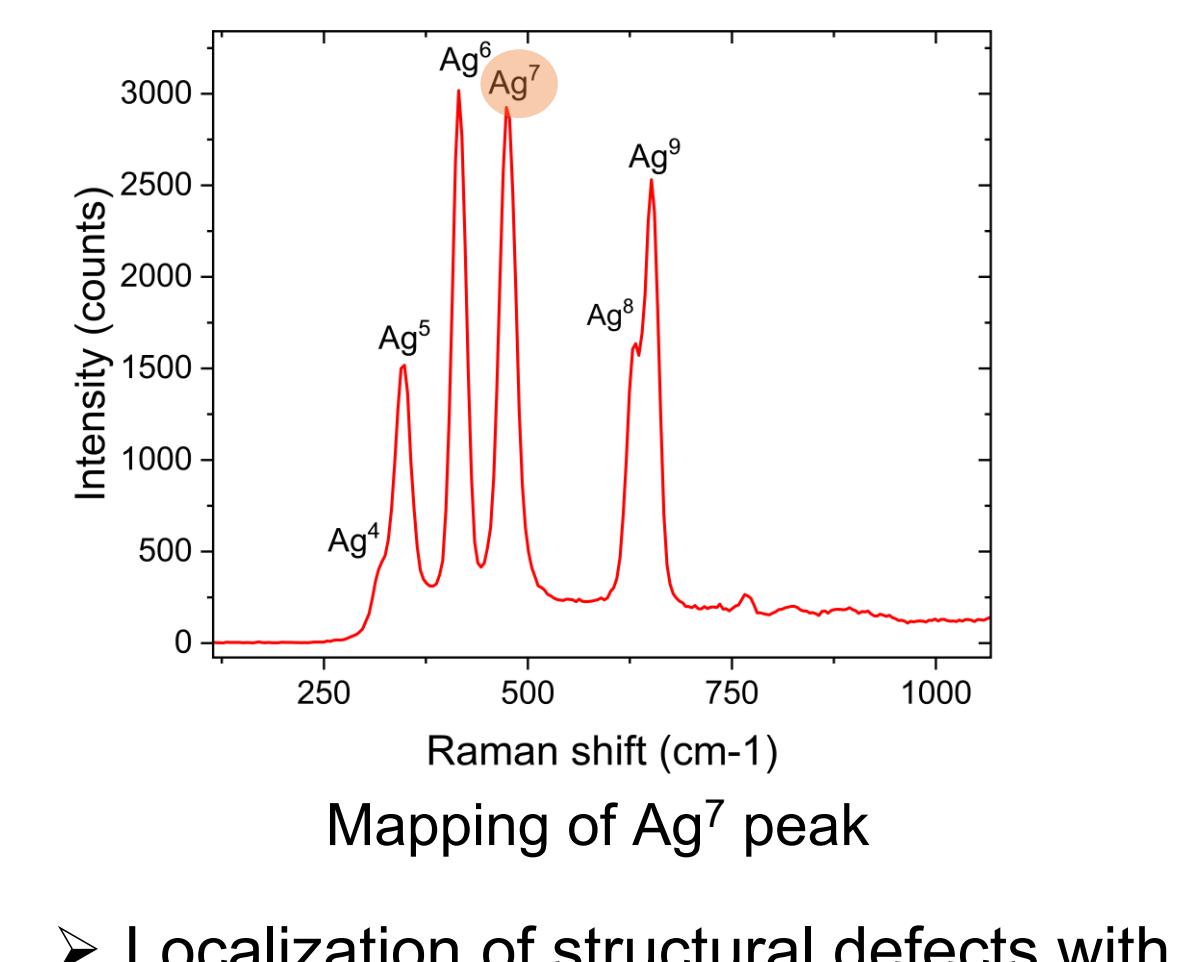
### PL mappings with UV laser



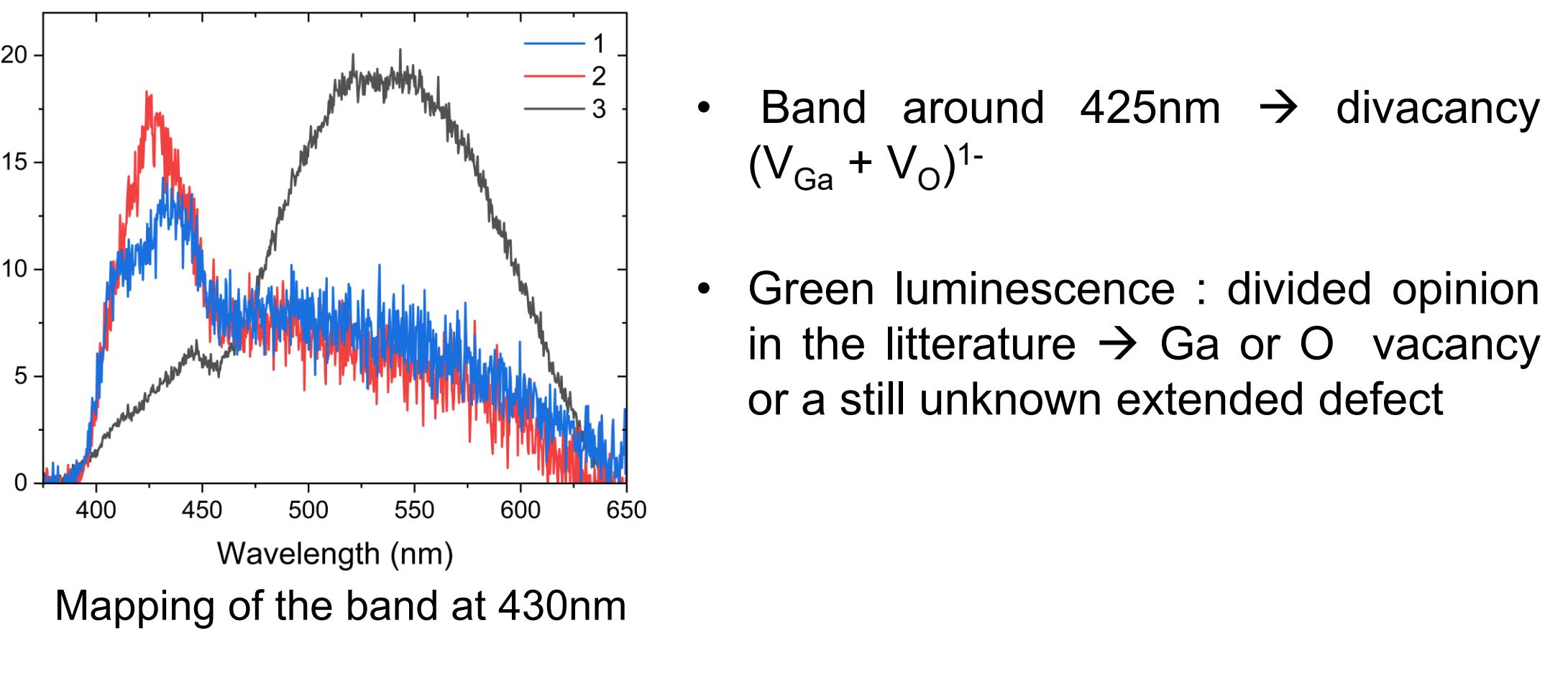
### Defects in $\beta$ -Ga<sub>2</sub>O<sub>3</sub> epilayer



### Raman mapping with UV laser



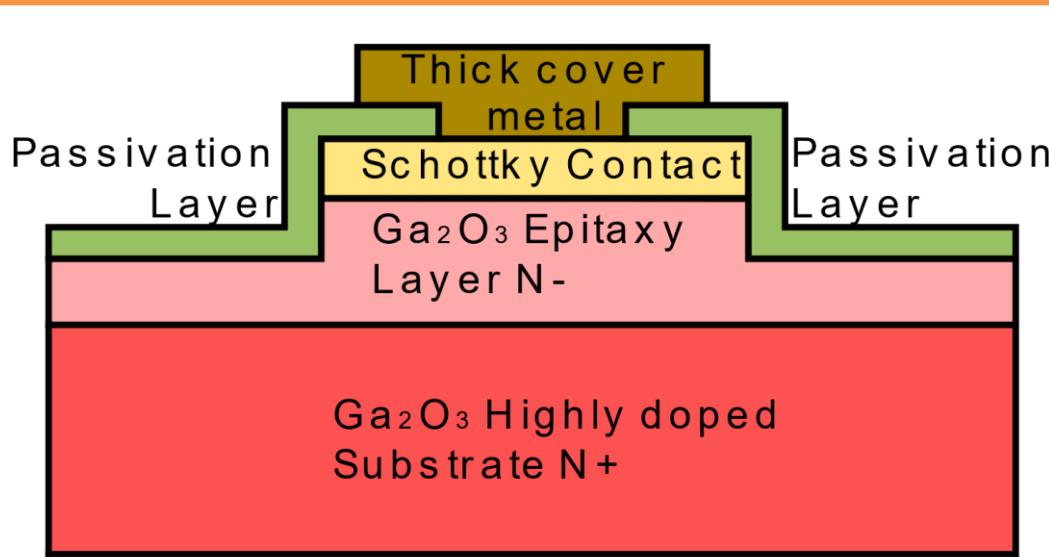
### PL mapping with UV laser



## Conclusion and perspectives

- $\beta$ -Ga<sub>2</sub>O<sub>3</sub> monoclinic lattice leads to the weak symmetry of the crystal  $\rightarrow$  the orientation of the substrate affects the Raman spectra
- Doping has little to no effect on Raman measurements
- Stress at the border of the substrate can be identified with Raman mapping
- PL measurements allow the location of point defects within the samples that are not visible with Raman

**Future work** : conception of a Schottky diode in  $\beta$ -Ga<sub>2</sub>O<sub>3</sub> to study the effects of material defects on electronic devices performances



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