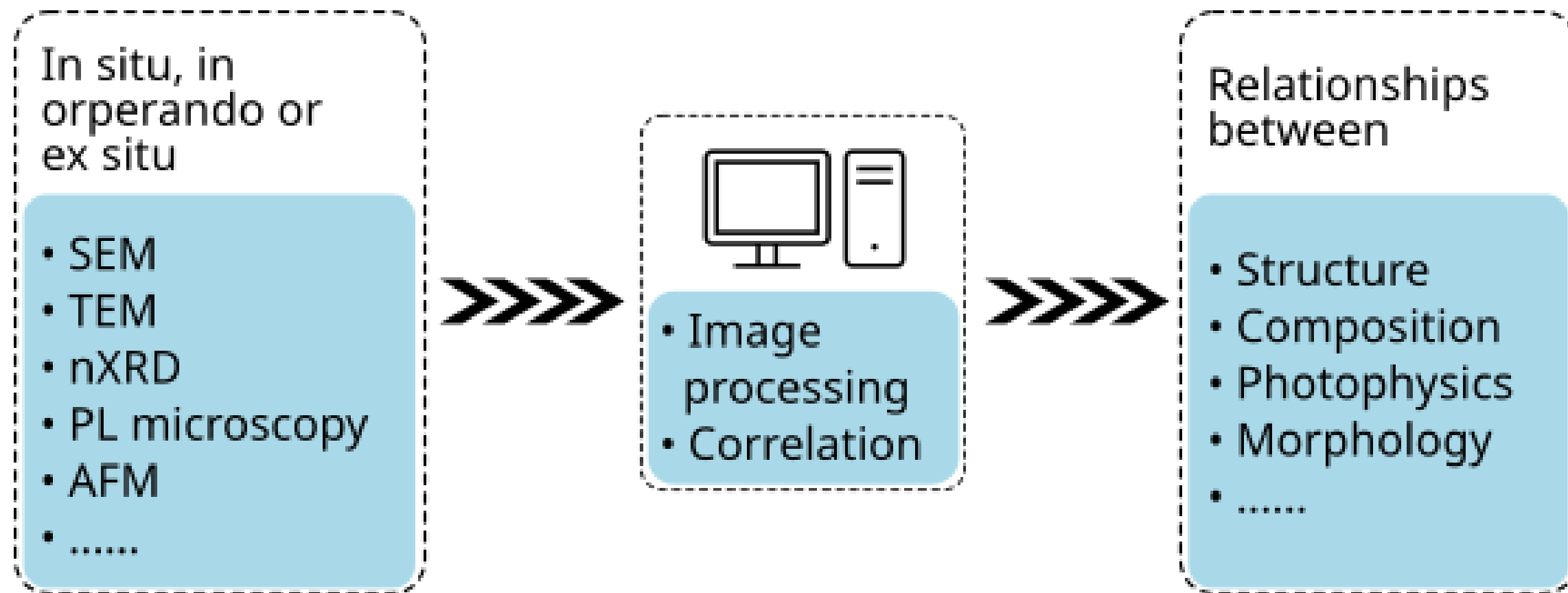


## Multimodal Measurements

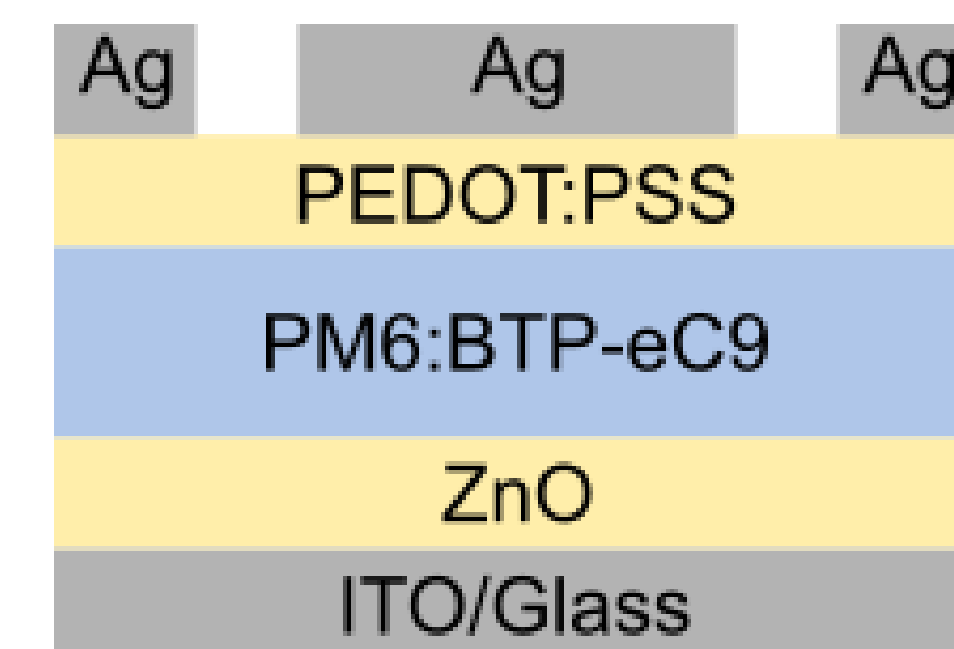
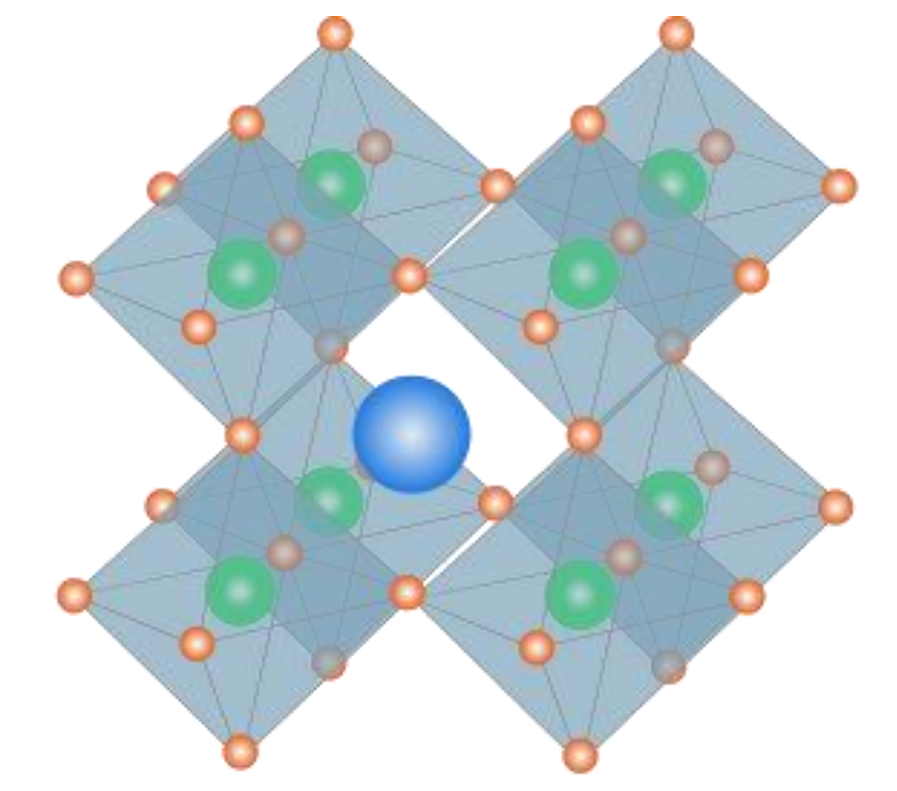


Multiple measurements performed either simultaneously or sequentially on the same scan area.

Powerful approaches to drawing structure-function-performance relationships<sup>[1]</sup>.

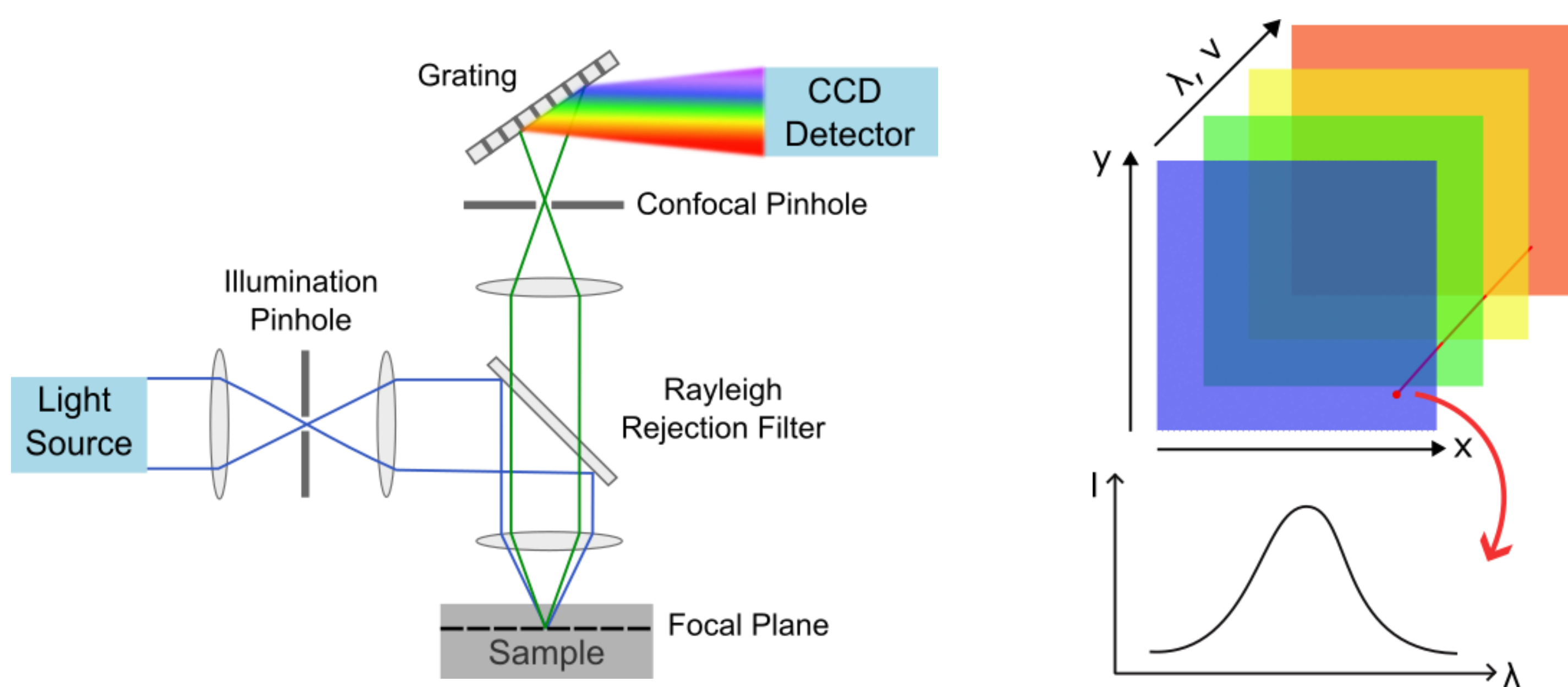
## Materials of Interest

Halide perovskite materials and devices exhibit heterogeneity in the chemical, structural and optoelectronic properties on different length scales.

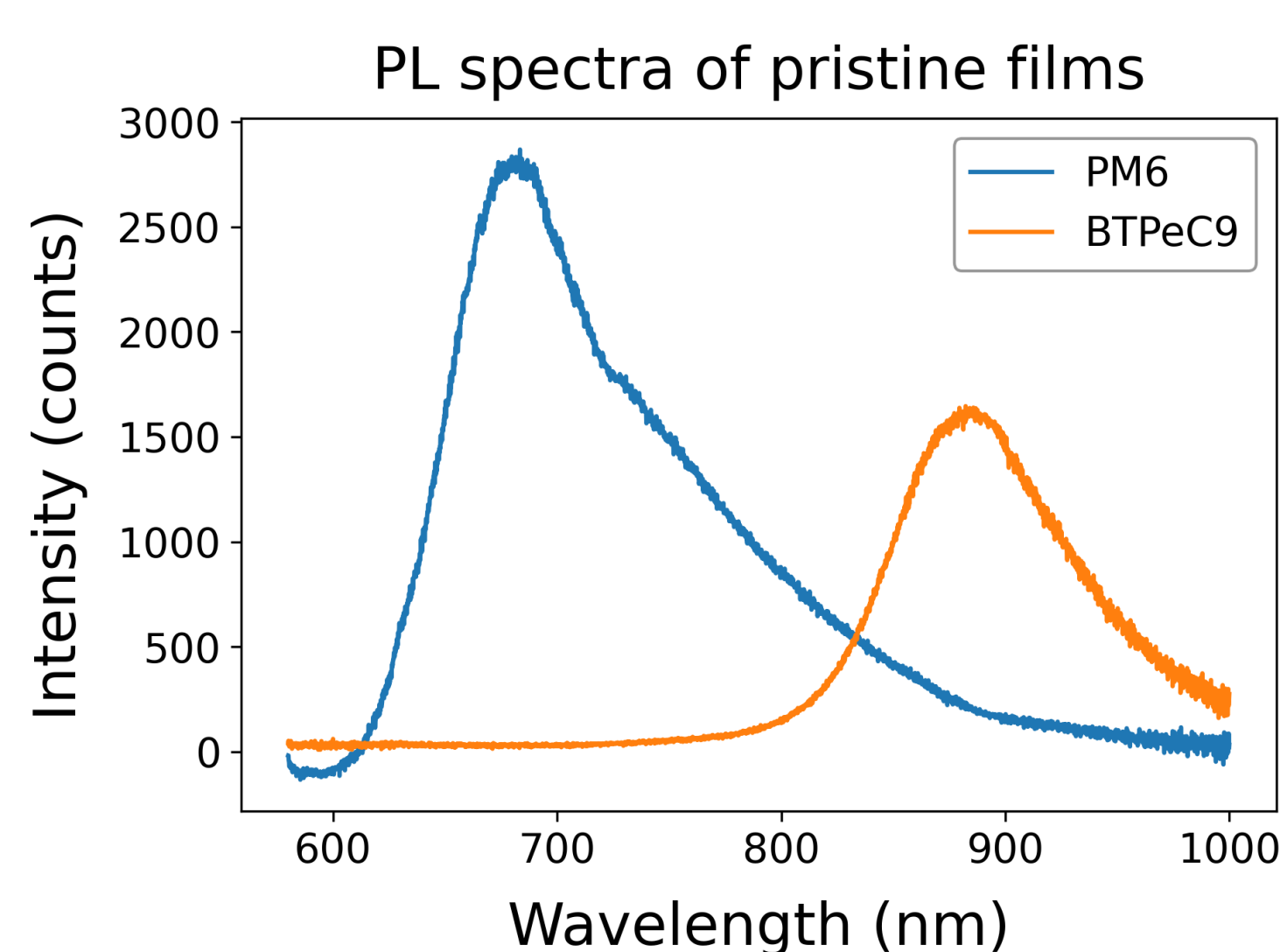
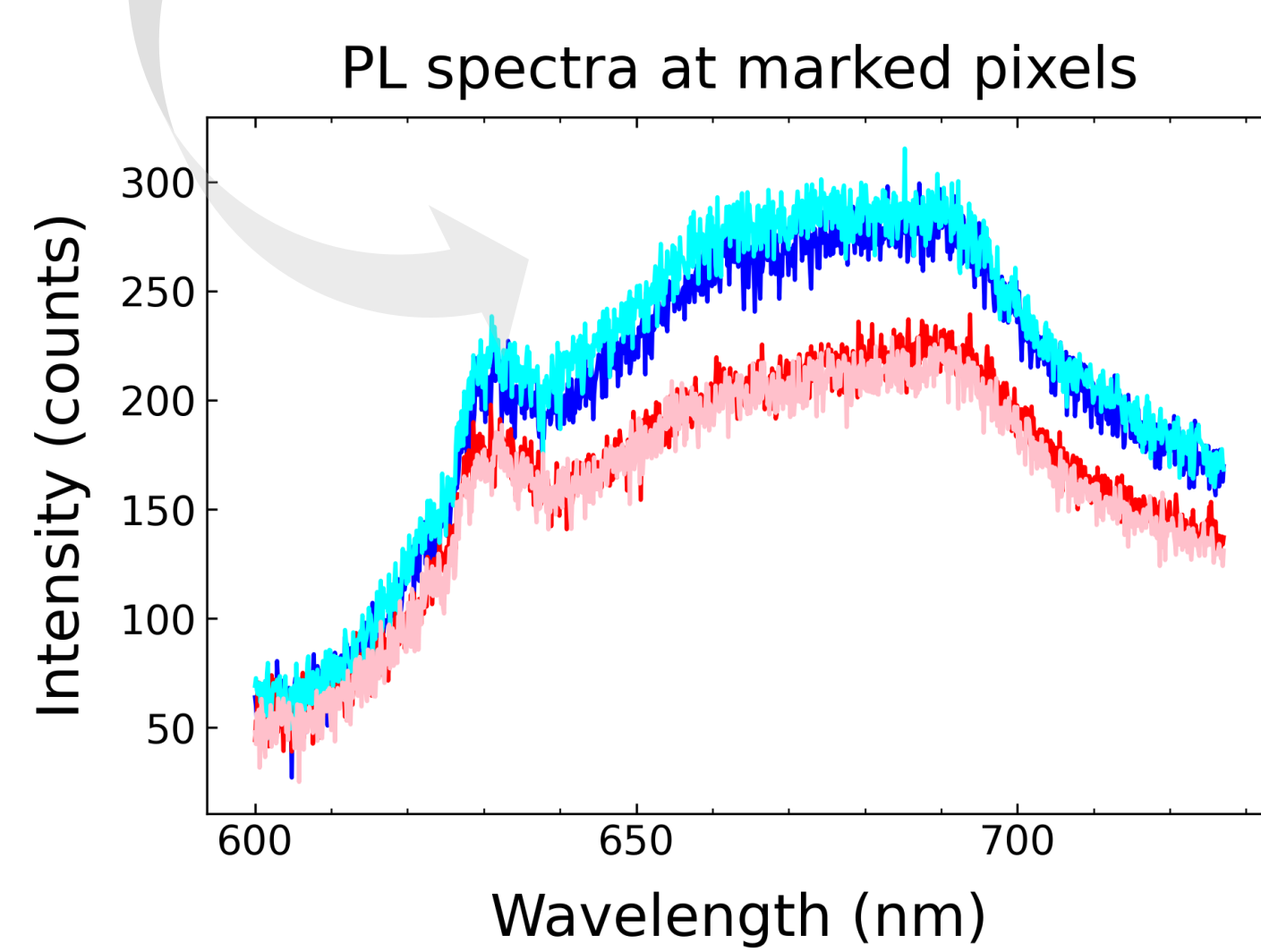
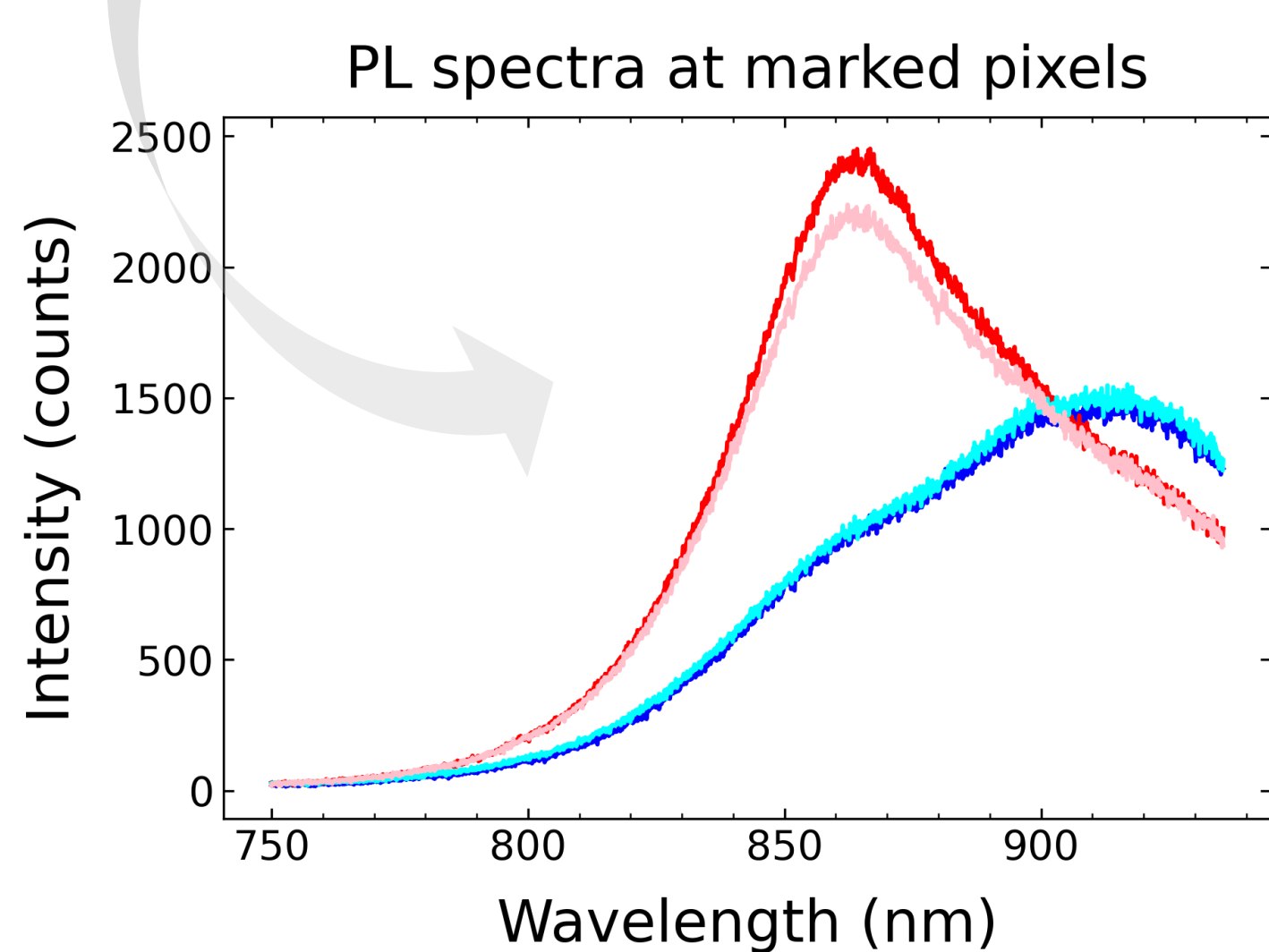
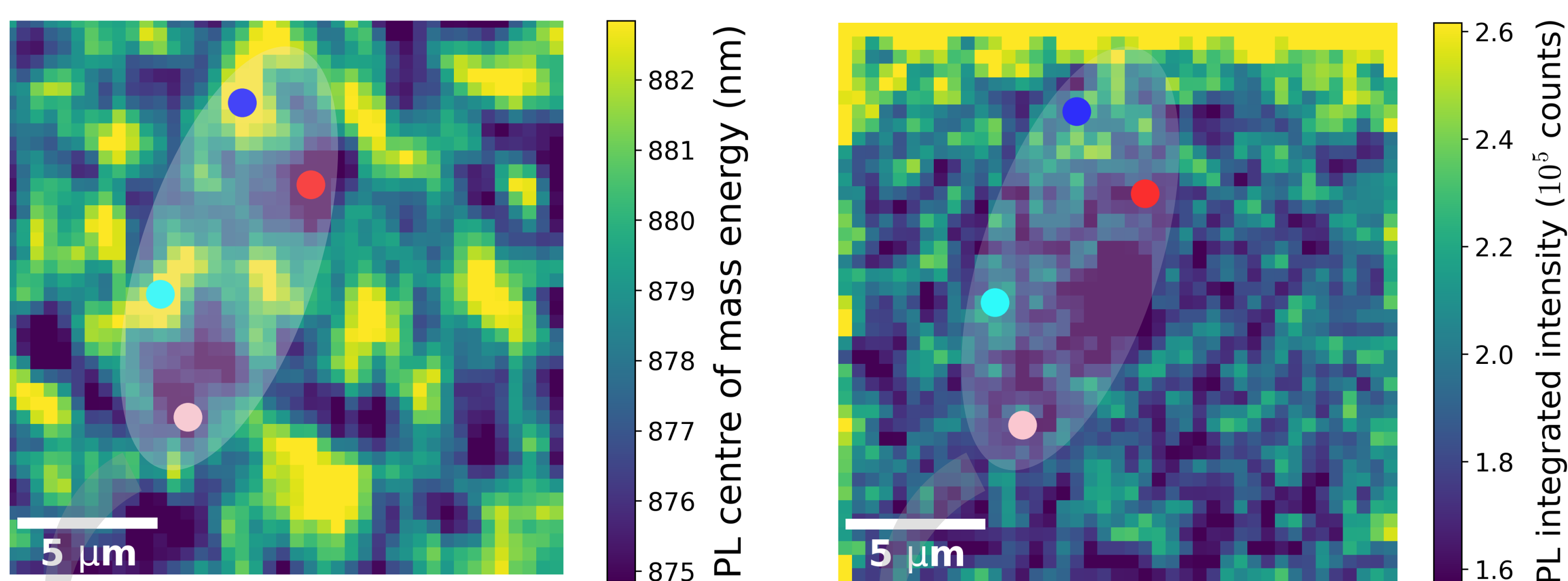


The morphology of the blended active layer in organic solar cells plays an important role in the performance.<sup>[2]</sup>

## Confocal Raman & PL Microscopy

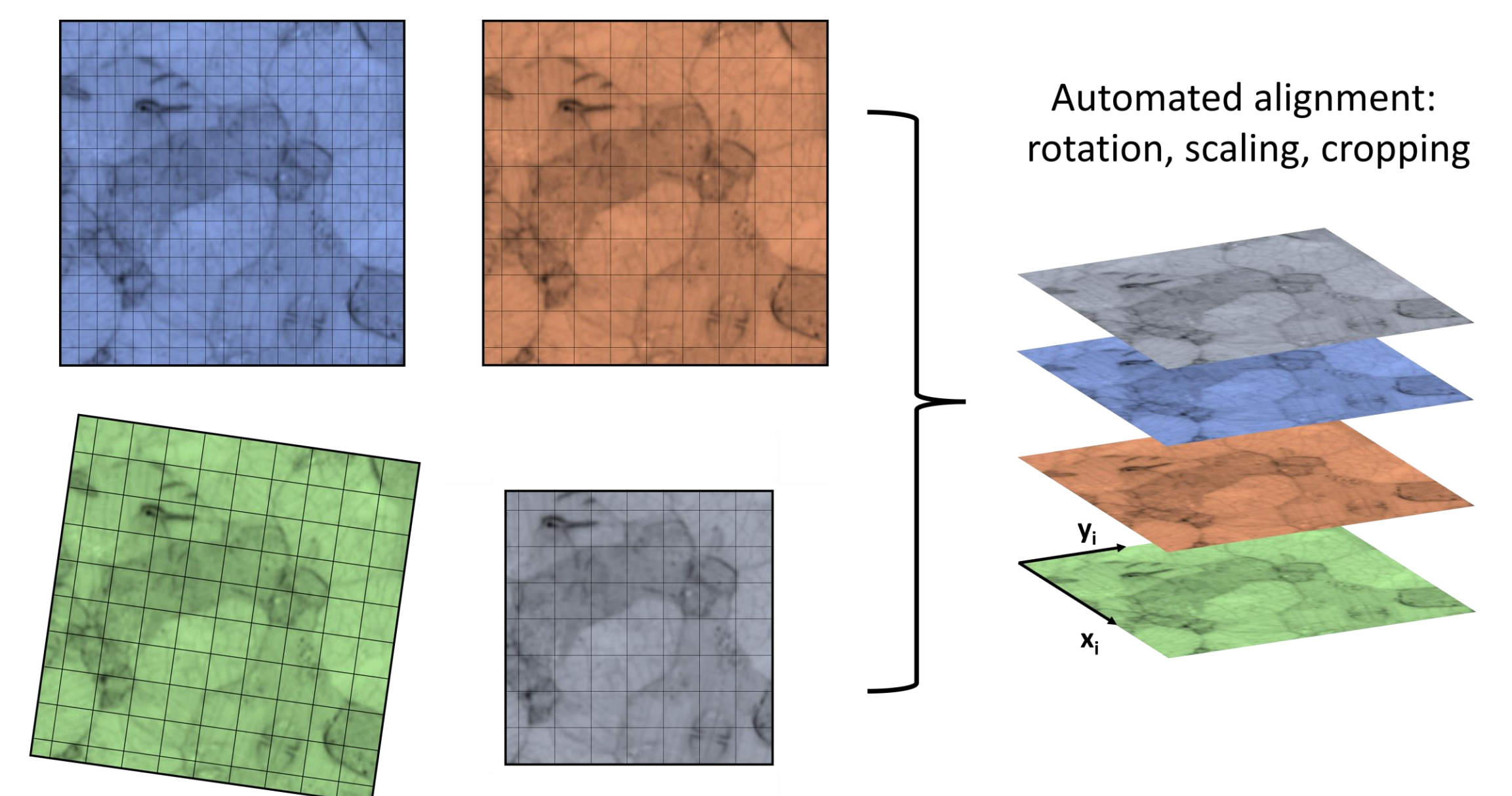


Hyperspectral PL and Raman data provide variations in local photophysical properties and spatially varying vibration modes associated with chemical structures and orientation, respectively.

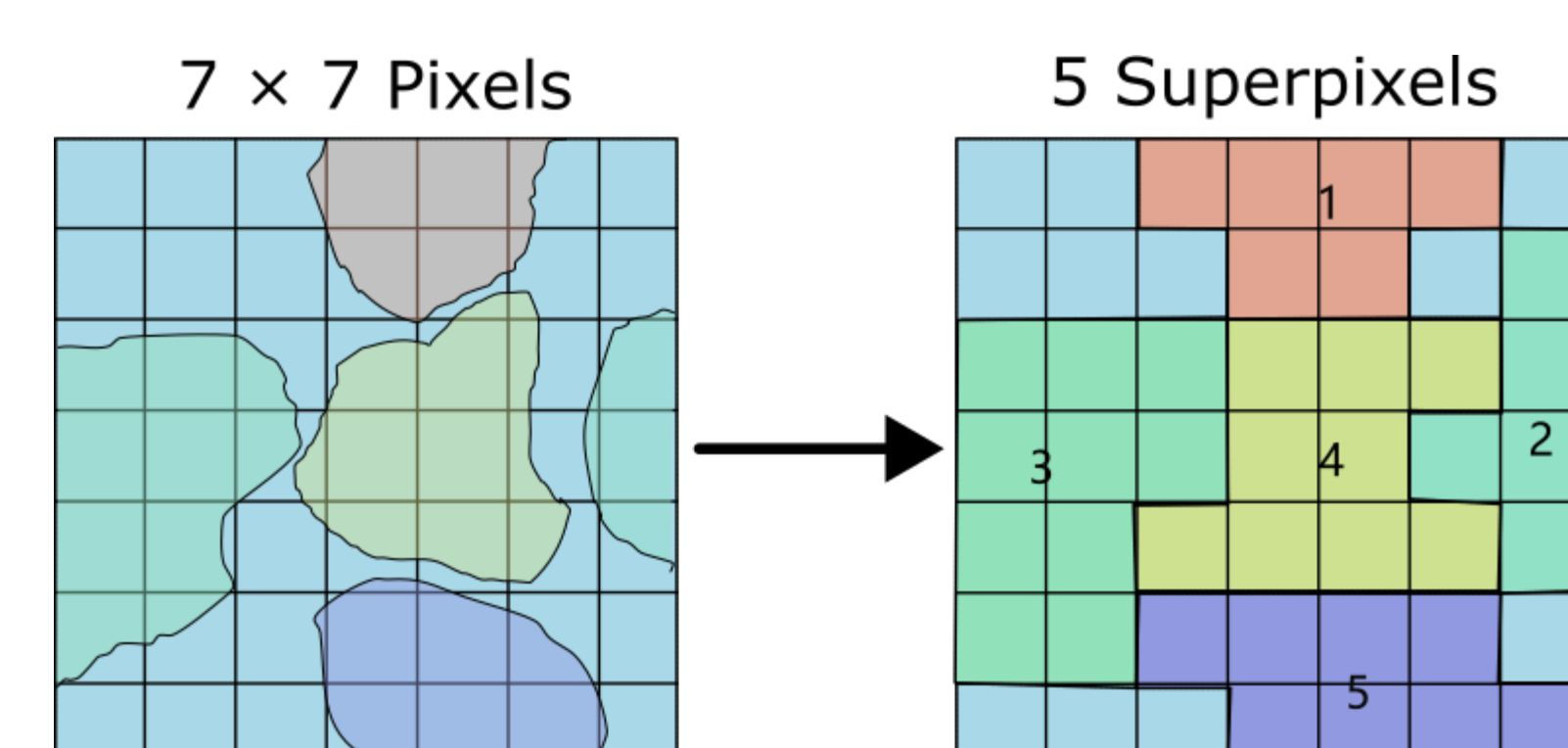


PL maps exhibiting PL wavelength and intensity shift reveal spatial variations of dominant emitter of PM6:BTP-eC9-based organic solar cell.

## Data Processing



Data preprocessing to adjust the images acquired with different resolutions, in different positions, or by different equipment based on features or fiducial markers.



Classification of the pixels sharing similar characteristics.

## Image Segmentation

An approach to reducing complexity of image processing tasks and a fundamental building block of machine learning method in materials image processing.

## Summary & Outlook

Hyperspectral PL can give insight into the local photophysical properties associated with local components in organic blends.

Combining PL and Raman mapping, it is possible to get further understanding of the relationship between local photophysical properties and local chemical structures.

Image processing is crucial to matching multimodal images more precisely and extraction of local features in large datasets.

## Acknowledgement

We are thankful to Dr Chen Wang for providing organic solar cells and studied thin films.

[1] Stranks, Matter 4, 3852-3866, 2021

[2] Liang et al., Battery Energy, 20230073, 2024.