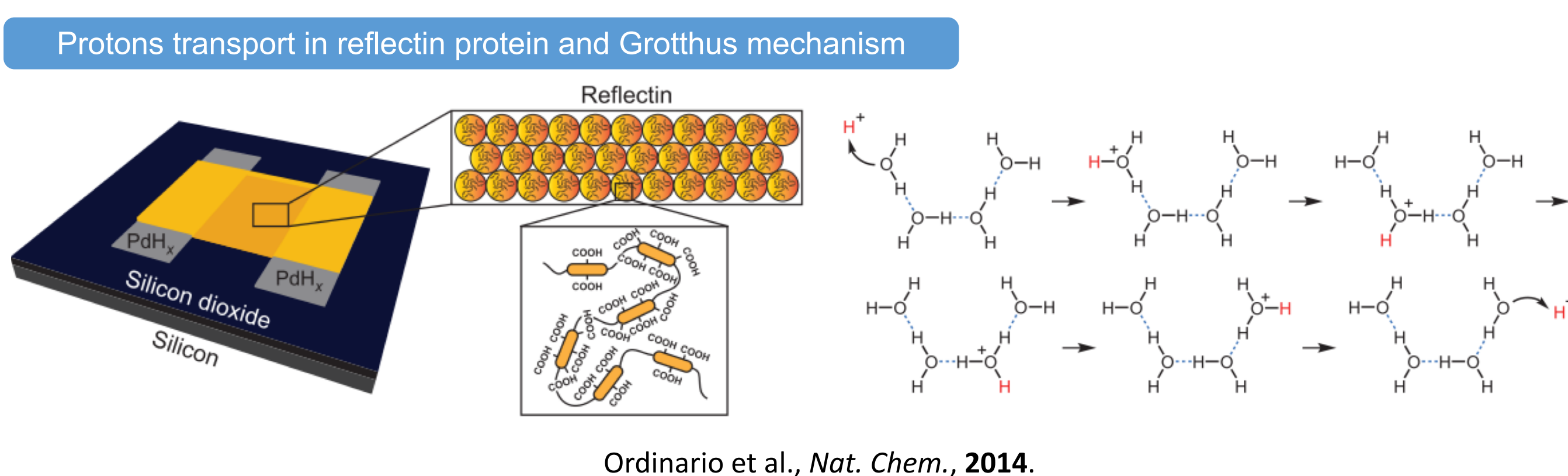
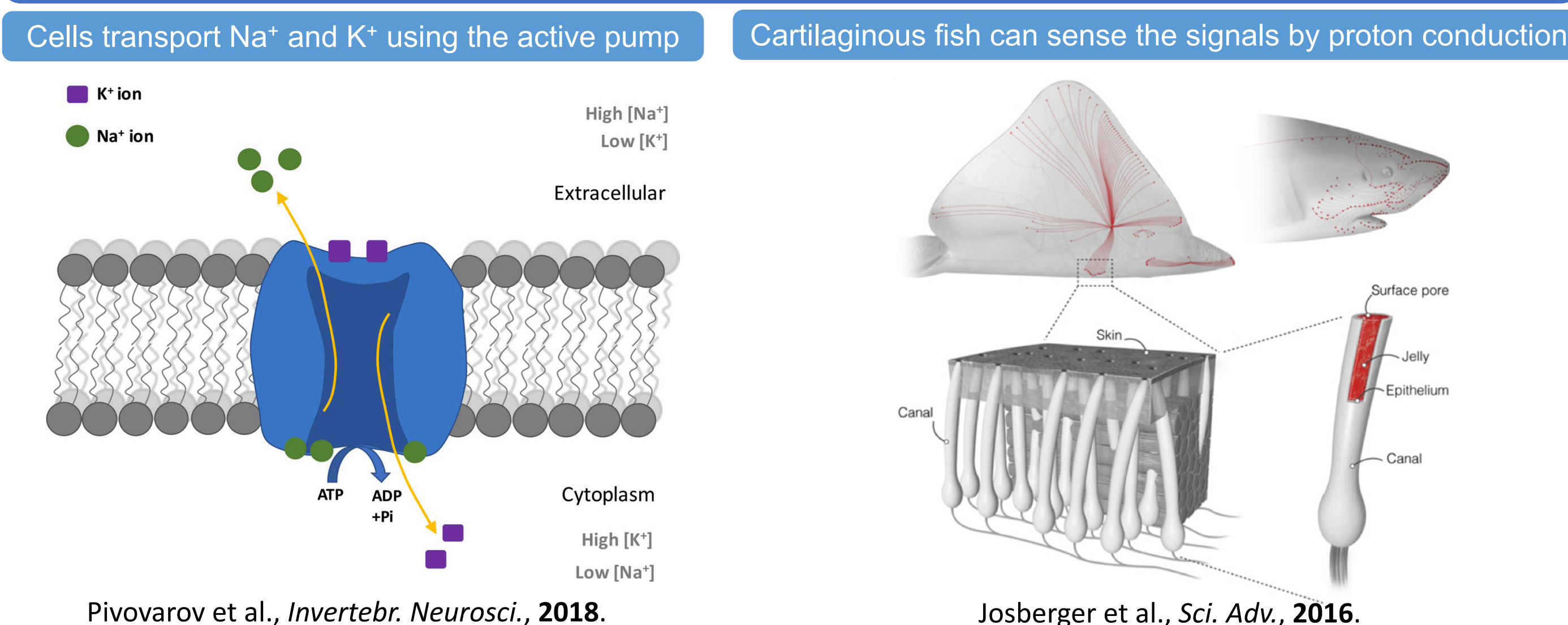


## Background

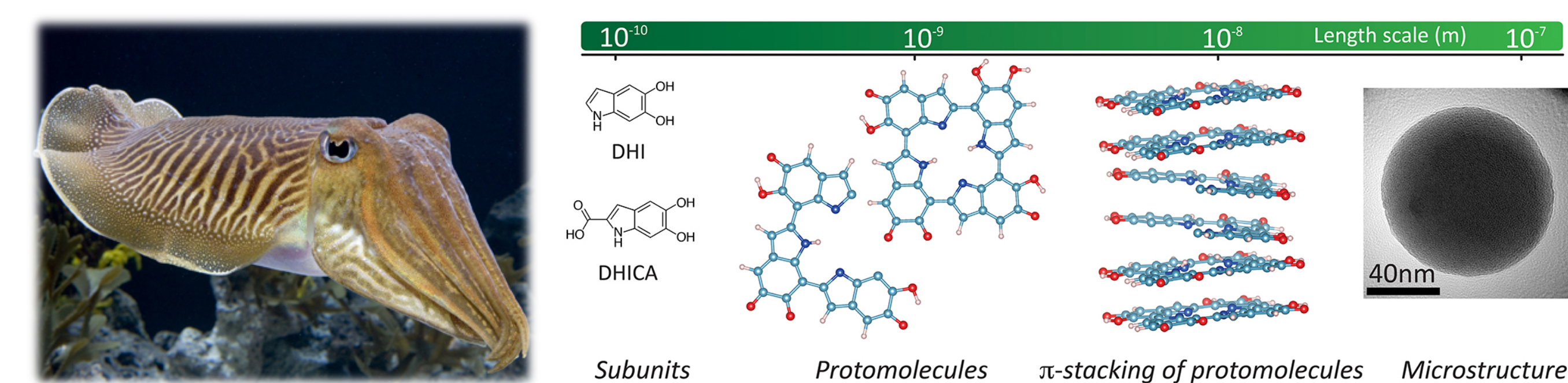
### Charge conduction in nature



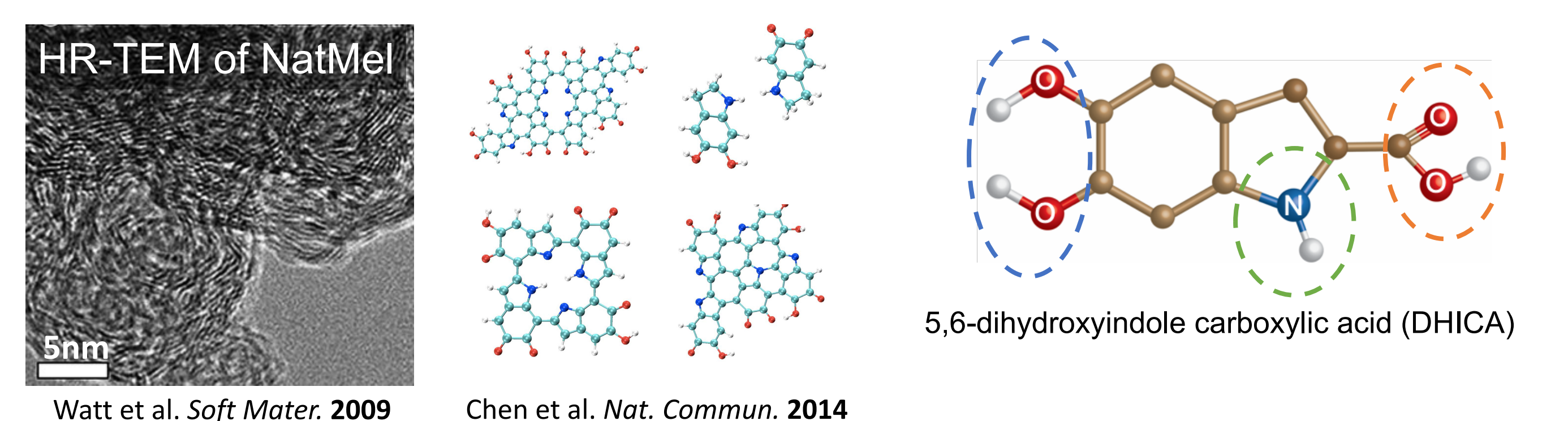
### Eumelanin pigments

- Biopigments found in skin, eyes or brain of many living organisms.
- Capabilities of conducting the charges by the redox active functional groups.
- Homogeneous nanoparticle structure.

### Synthesis



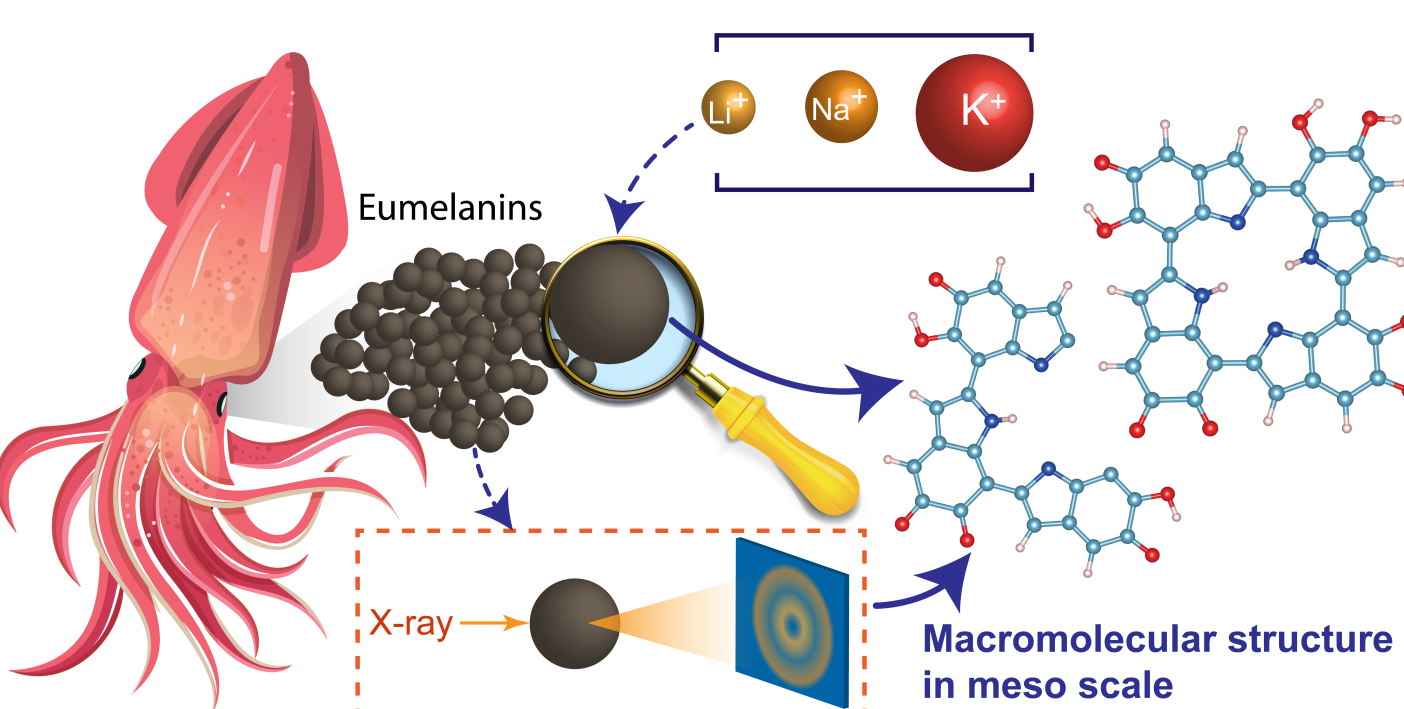
### Structure



Although the protomolecular structure of natural melanins have partially been validated using modeling and experimental techniques, more mechanistic studies are necessary to understand the structure and further engineer them into versatile materials.

### Experiment

Natural melanins can be investigated using X-ray scattering and electrochemical techniques. Synthetic melanins are used as the counterparts because of its similar chemical motifs with natural melanins.



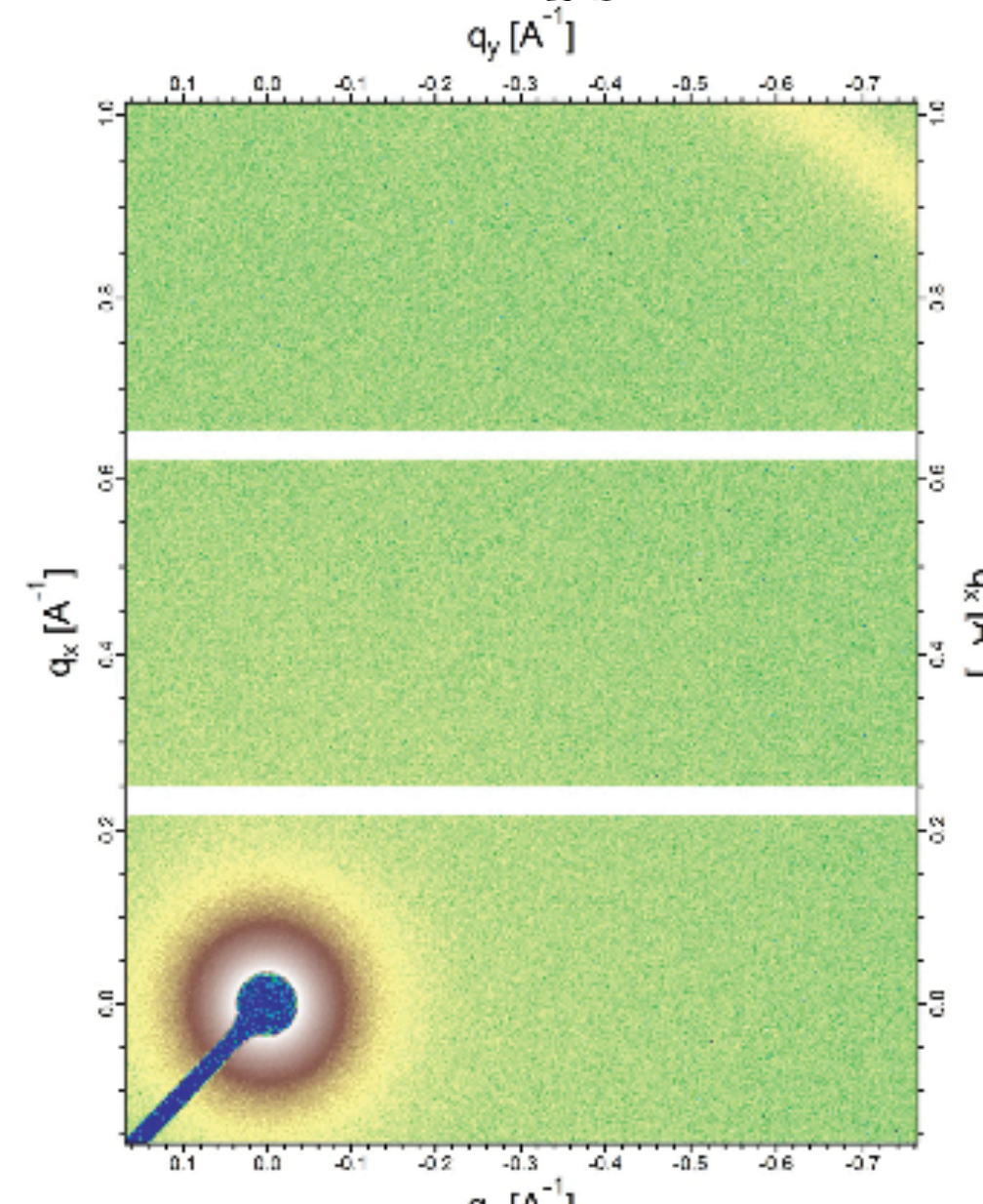
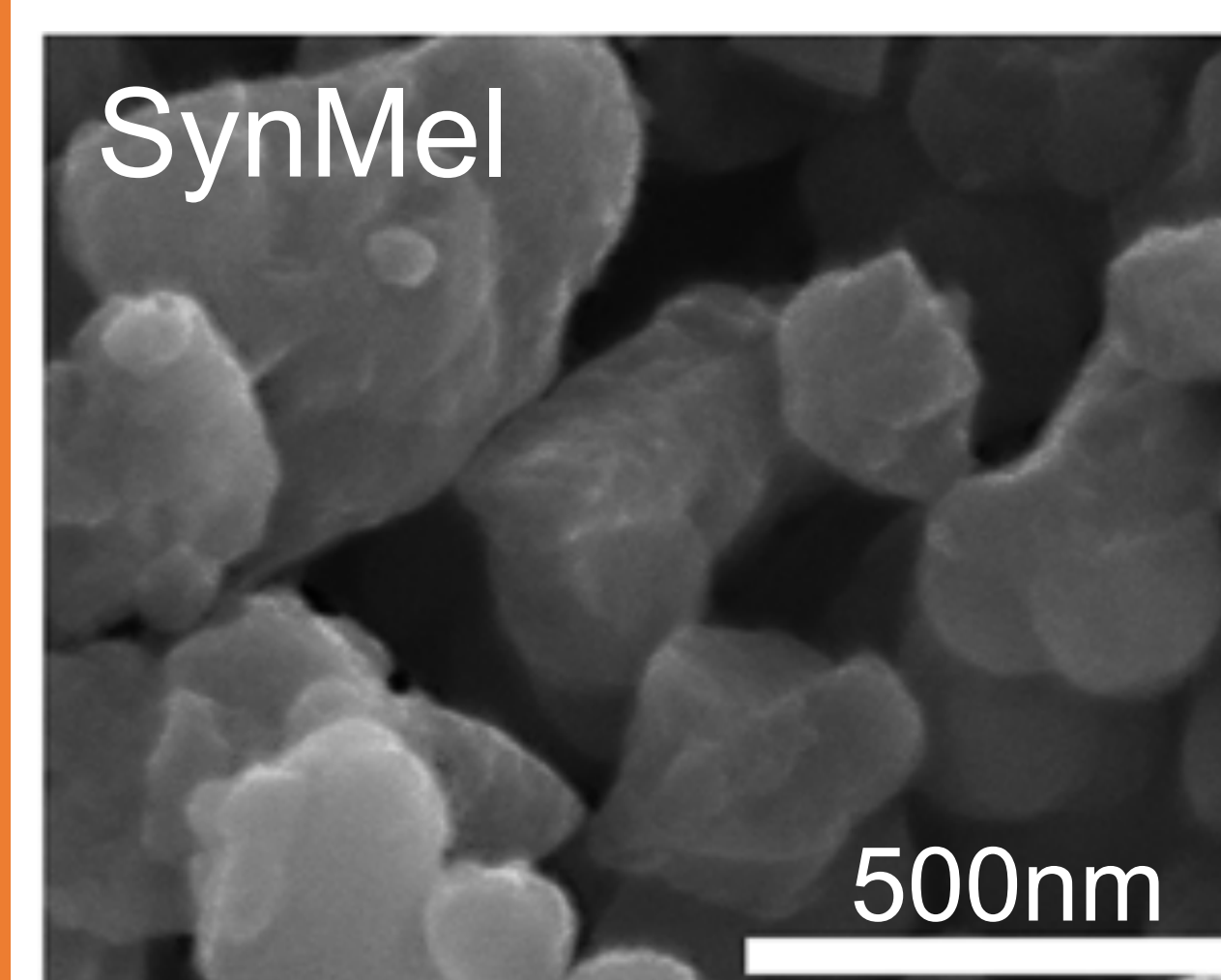
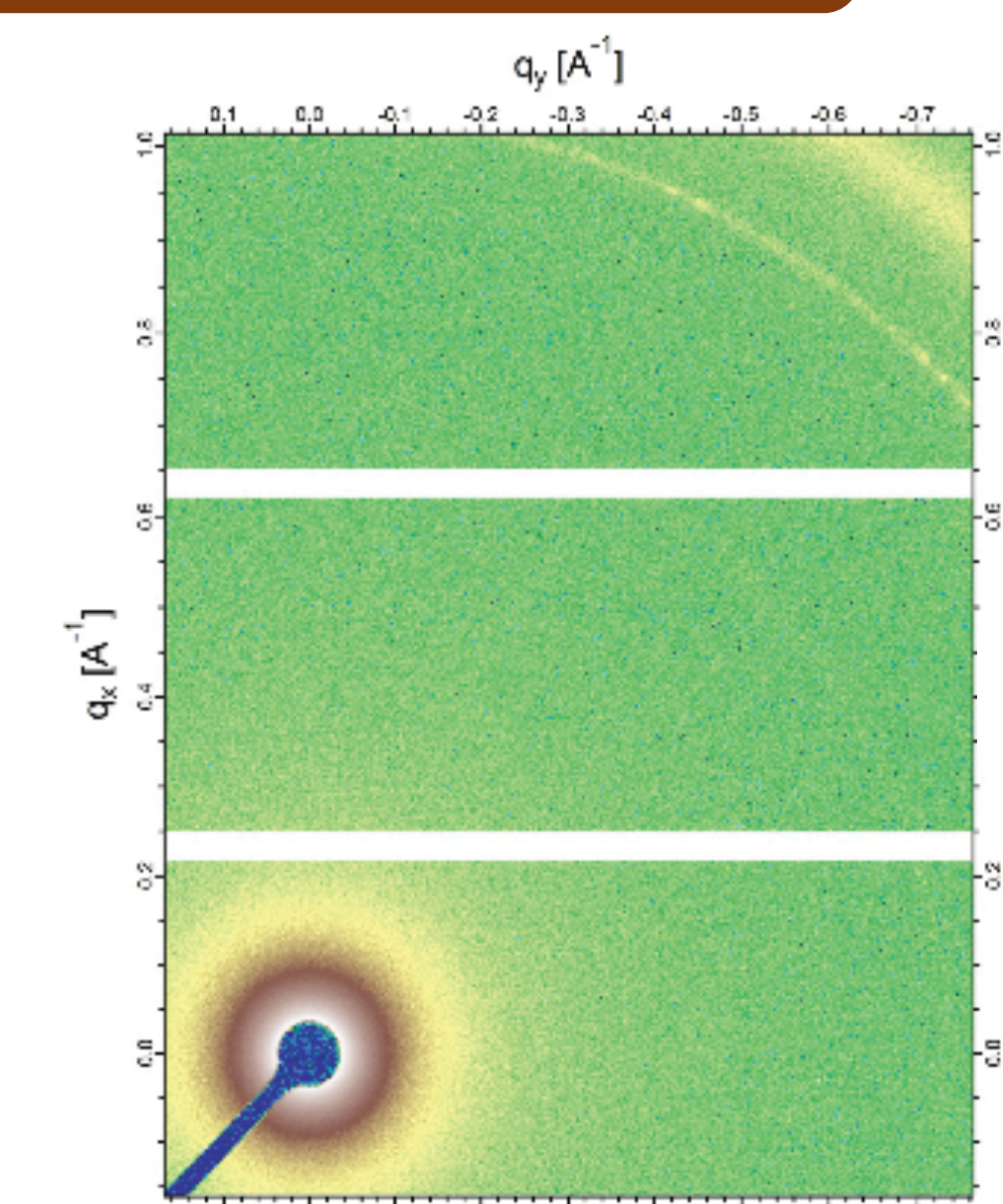
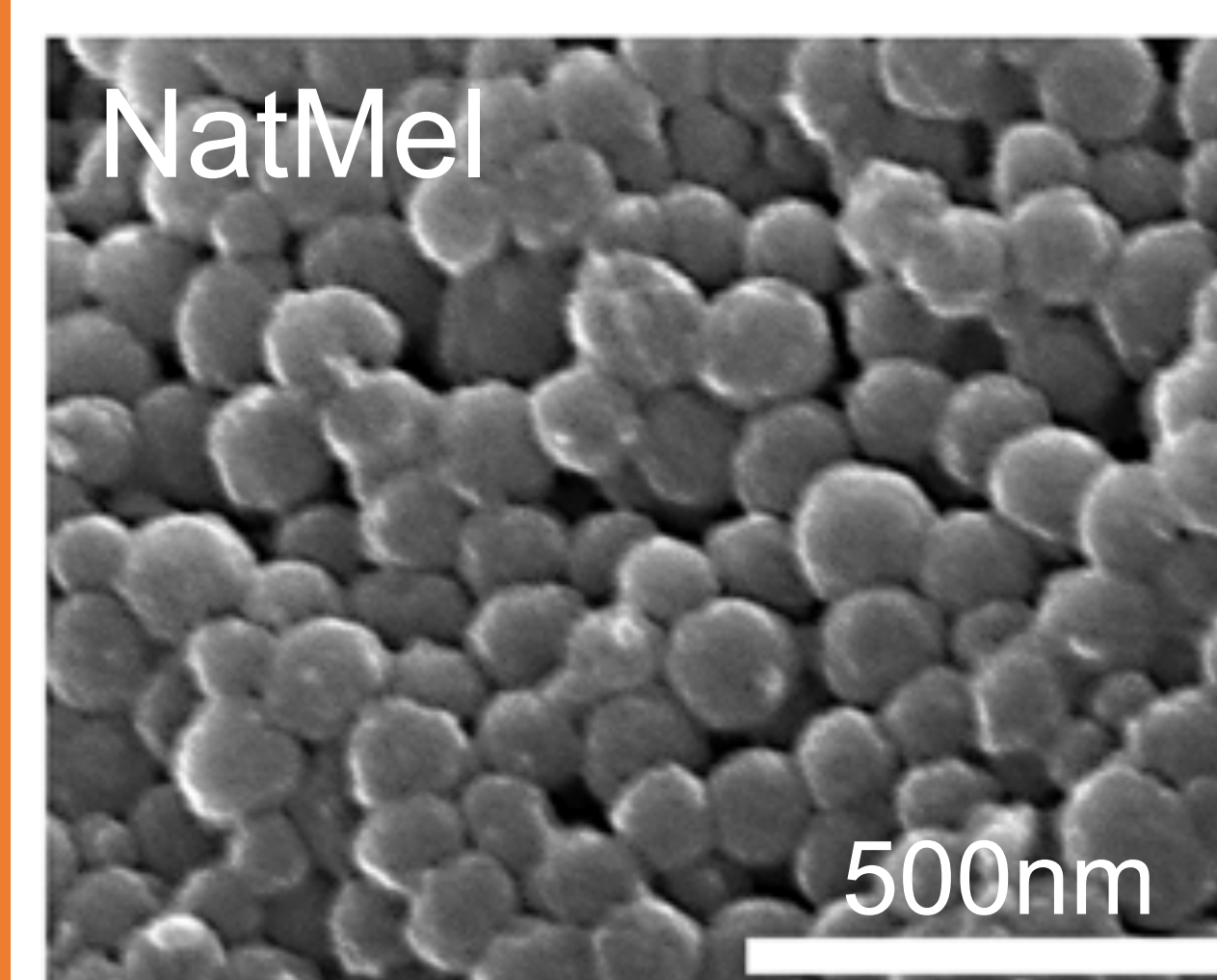
### Techniques

- Scanning electron microscopy (SEM)
- Small angle X-ray scattering (SAXS)
- Wide angle X-ray scattering (WAXS)
- Cyclic voltammetry (CV)
- X-ray photoelectron spectroscopy (XPS)

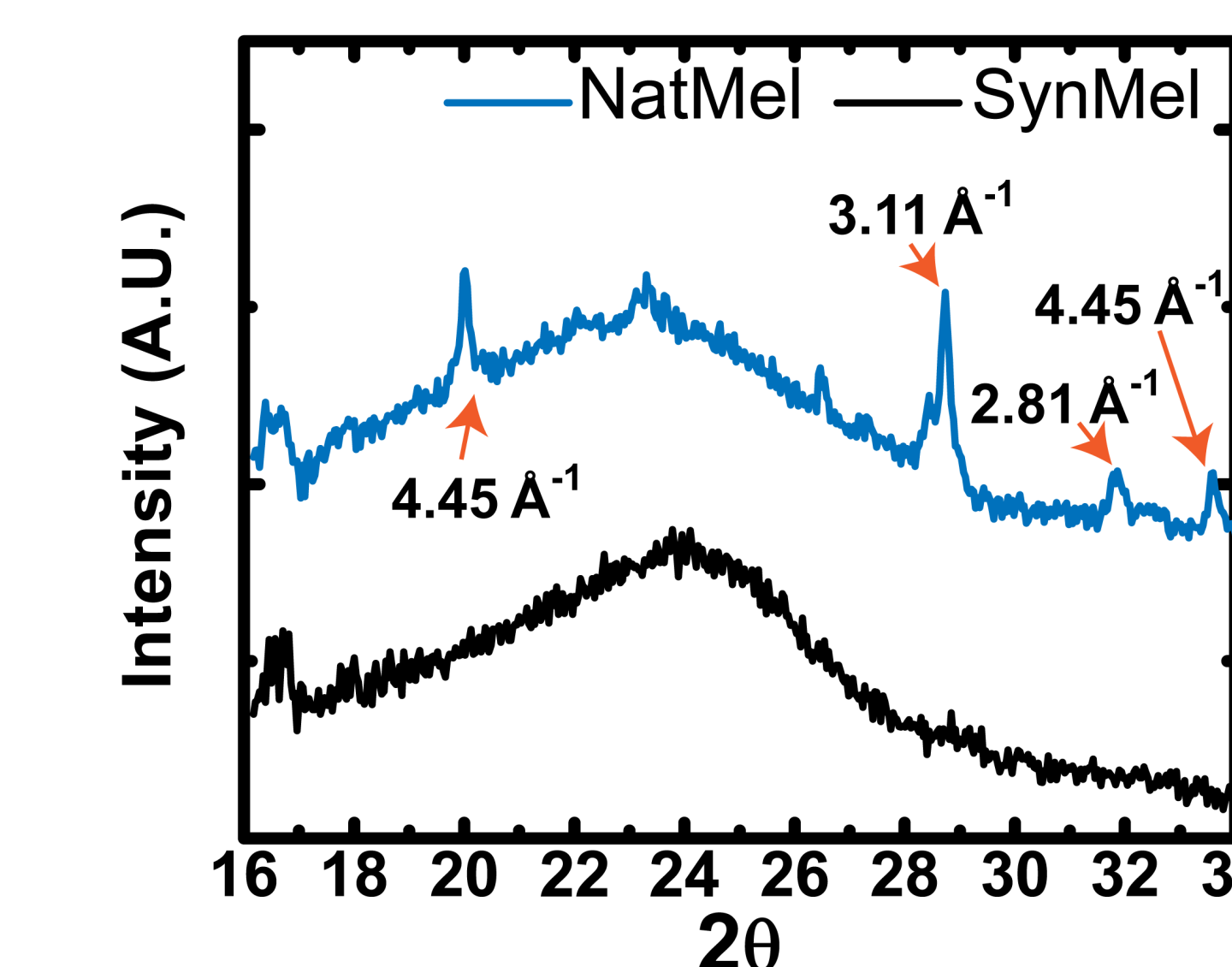
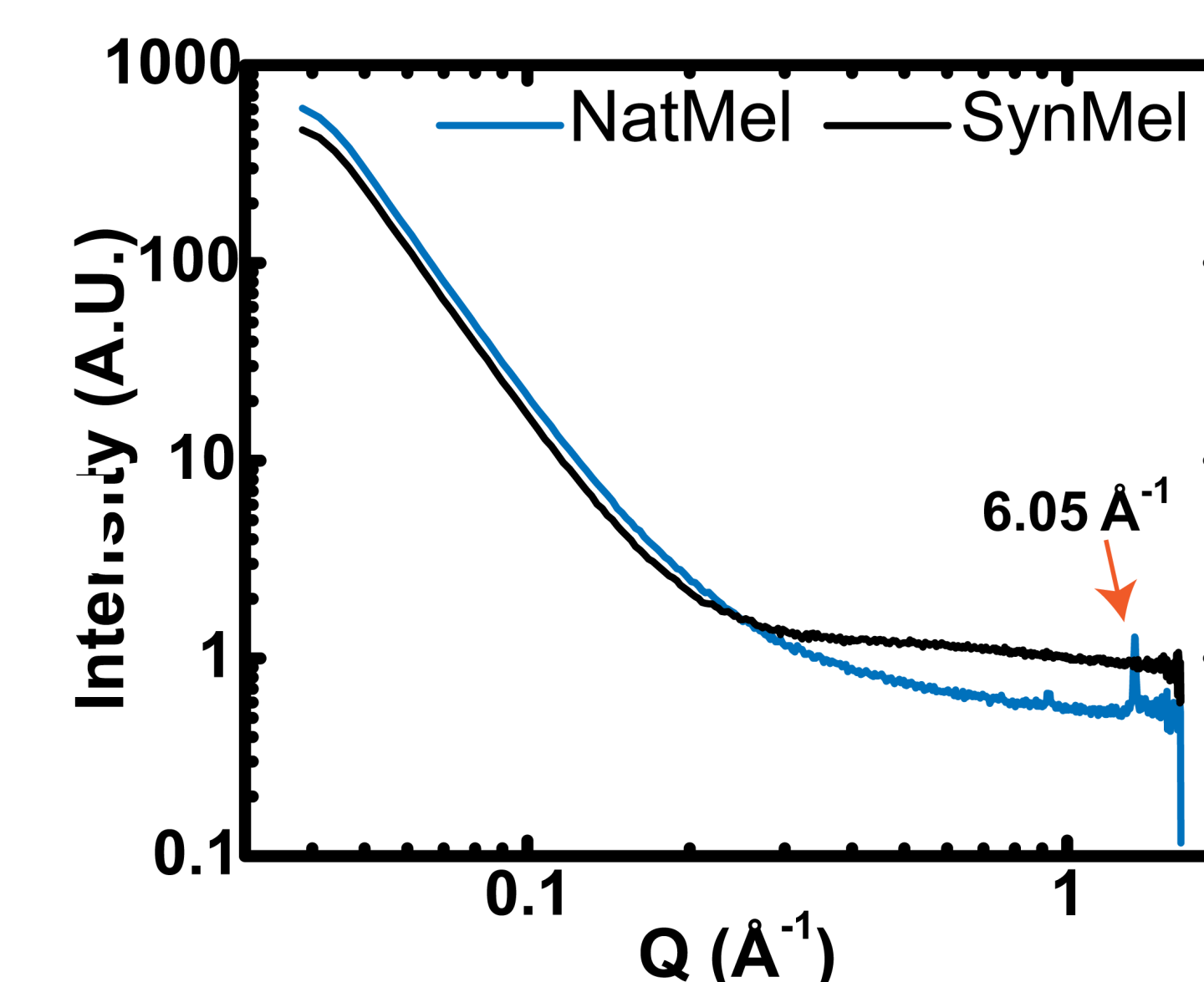
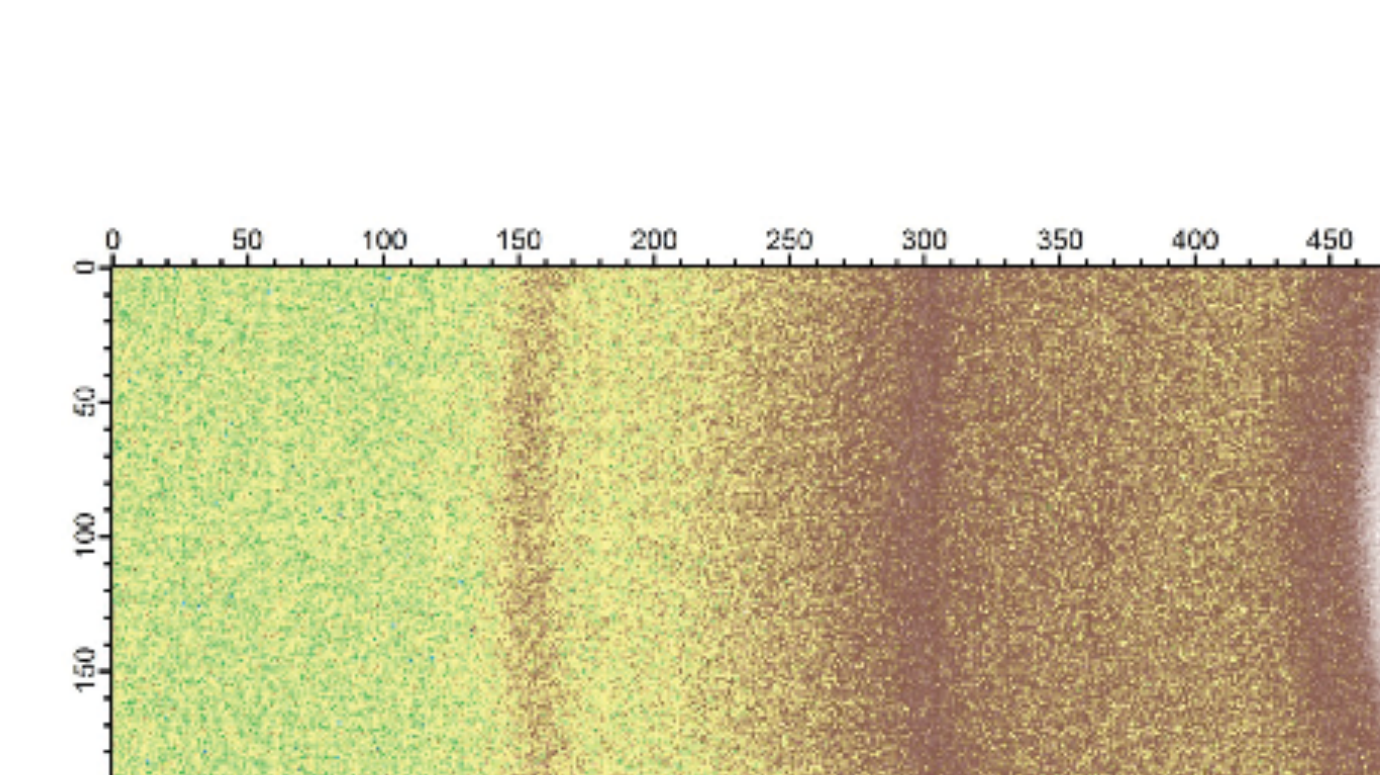
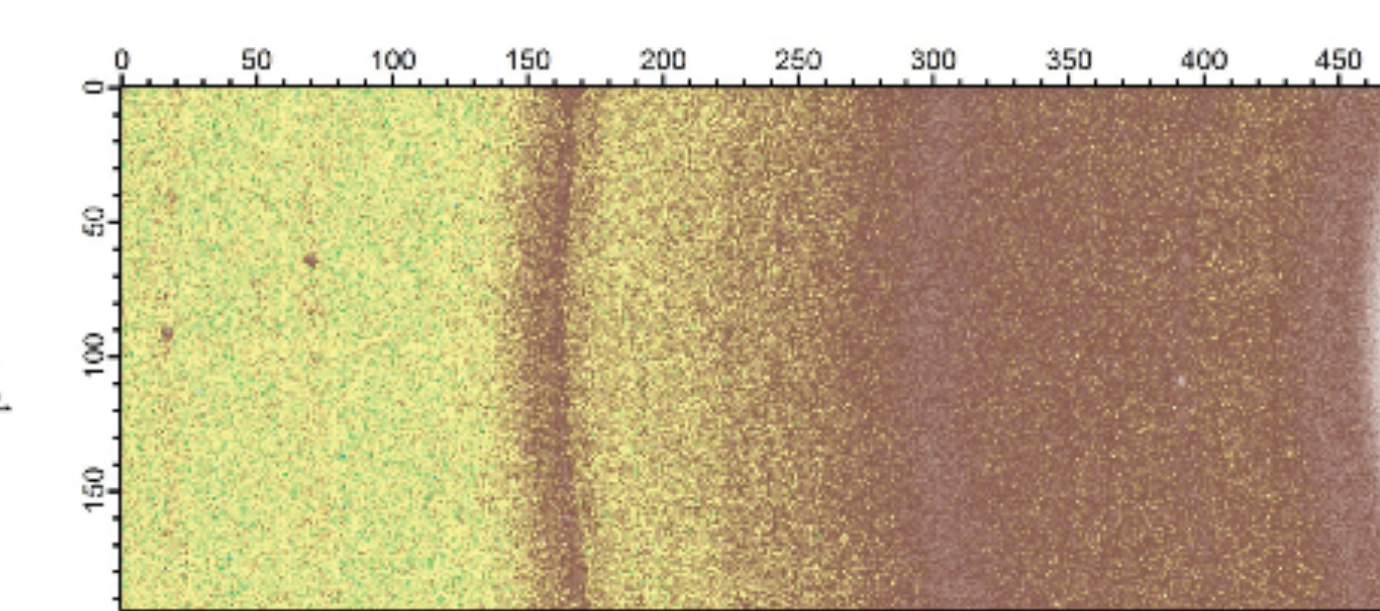
## Results & Discussion

### Microstructures of natural and synthetic melanins

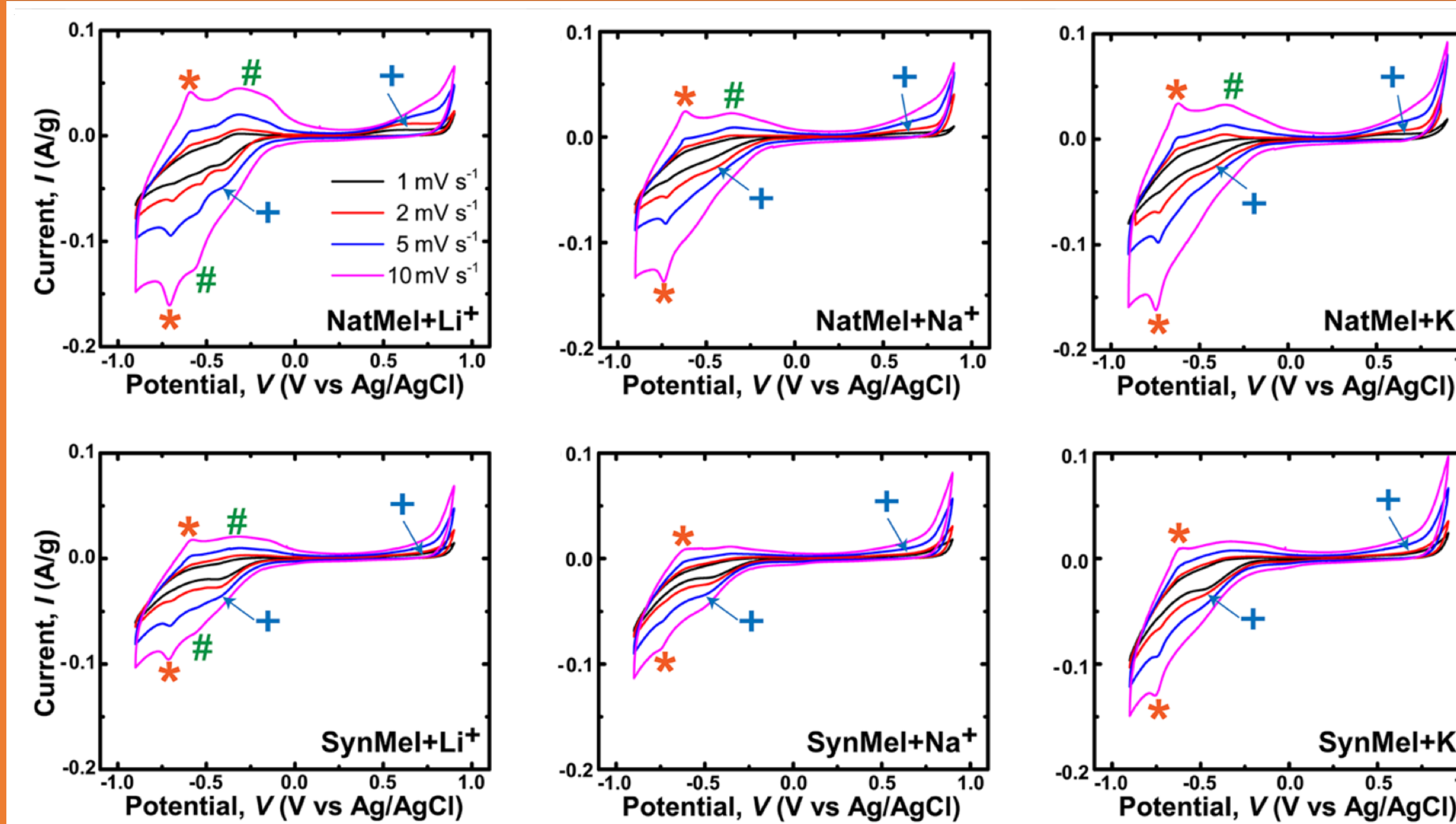
#### Scanning electron microscopy (SEM)



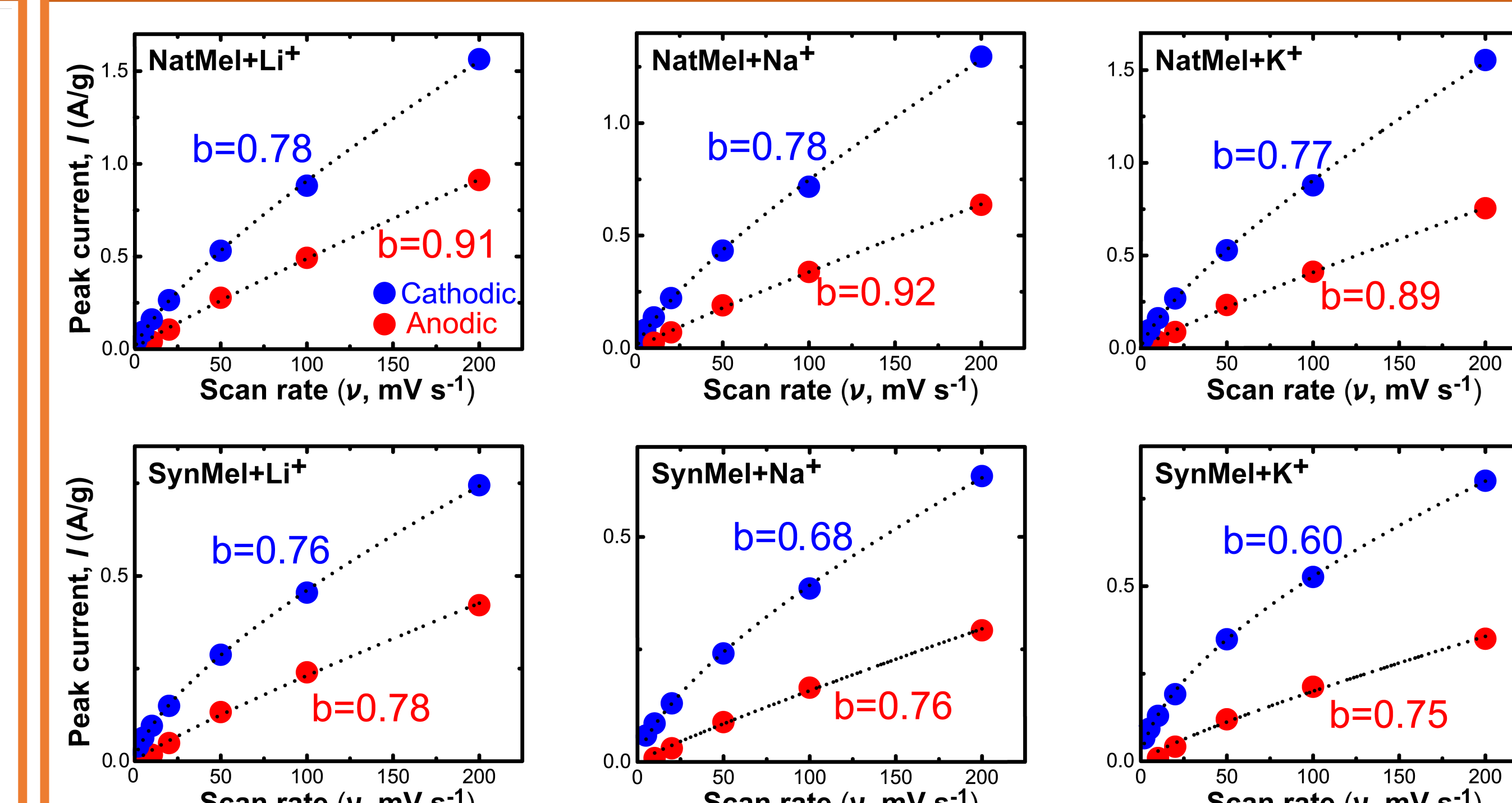
#### Small & large X-ray scattering (SAXS & WAXS)



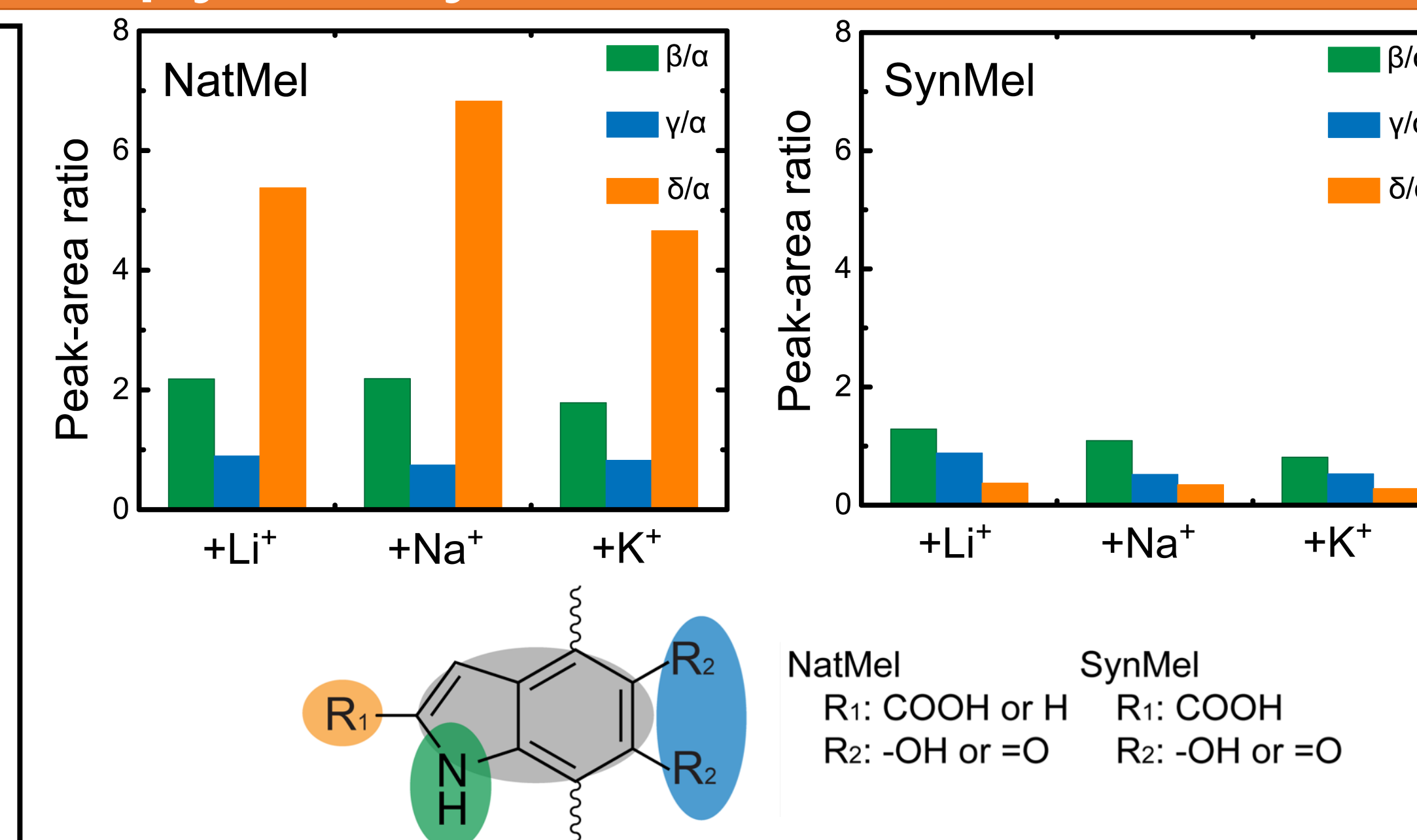
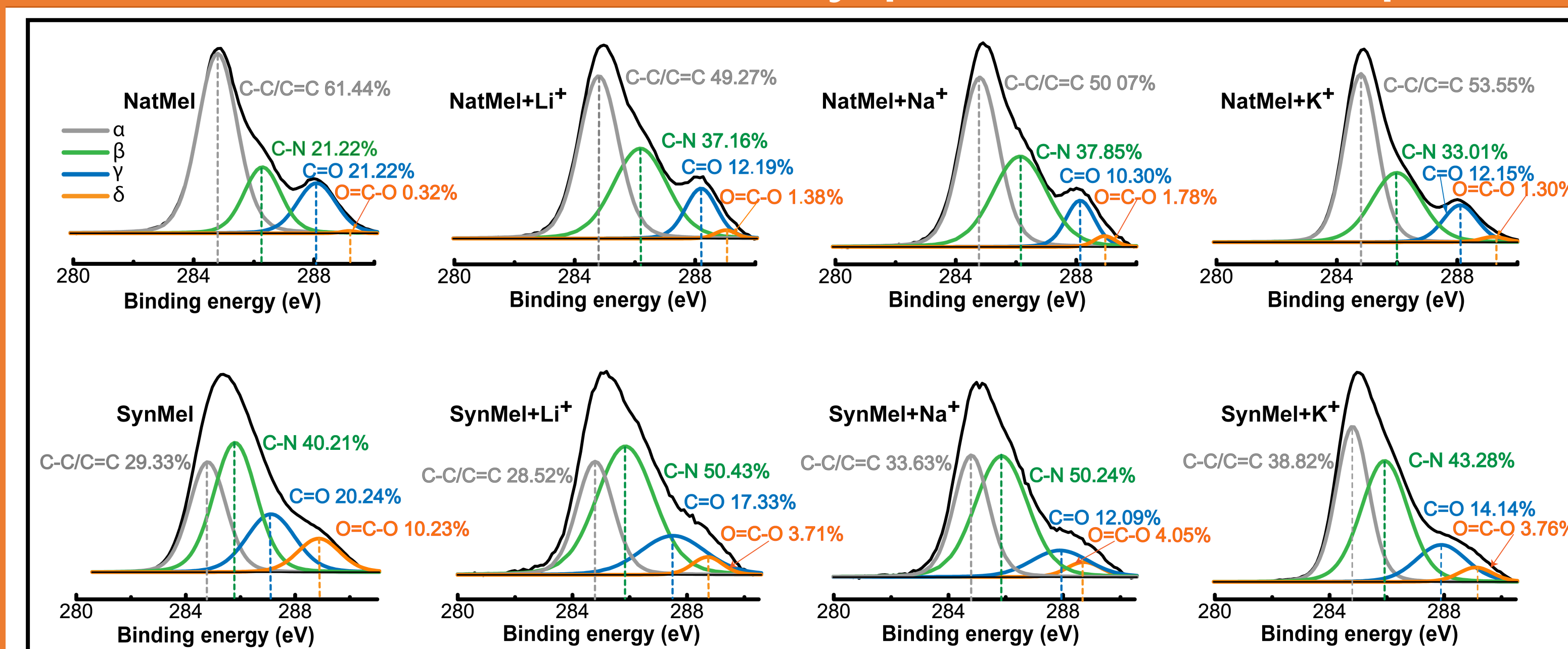
### Electrochemical analysis



### Electro-kinetics analysis



### X-ray photoelectron spectroscopy analysis



## Conclusion

- ❖ The semi-crystalline structure of NatMel contains ordered protomolecules in mesoscale.
- ❖ Cations could be transported through NatMel in a capacitance-limited manner, whereas SynMel exhibited the diffusion-limited transport.
- ❖ Cations form a coordination bonding mainly with pendant carboxylates during a redox reaction.
- ❖ NatMel can be modified into the pseudo-capacitor electrodes when forming the microstructures of 2D layers or 1D nanofibers.
- ❖ The electrodes for batteries can be synthesized with the bulk phase formation of SynMel.



SCAN ME