

# Micro-imaging characterization and release prediction of controlled release microspheres

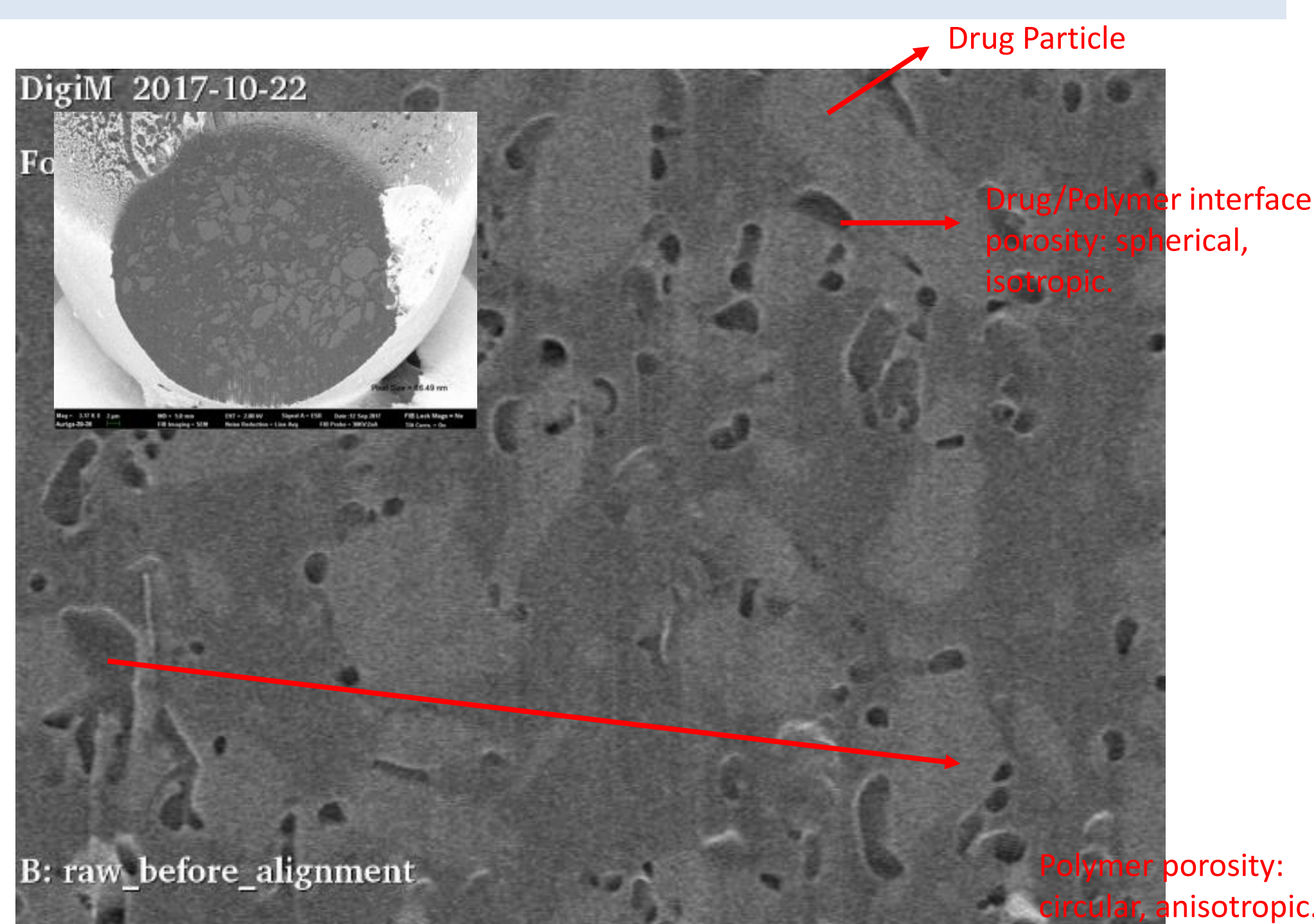
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## Motivation

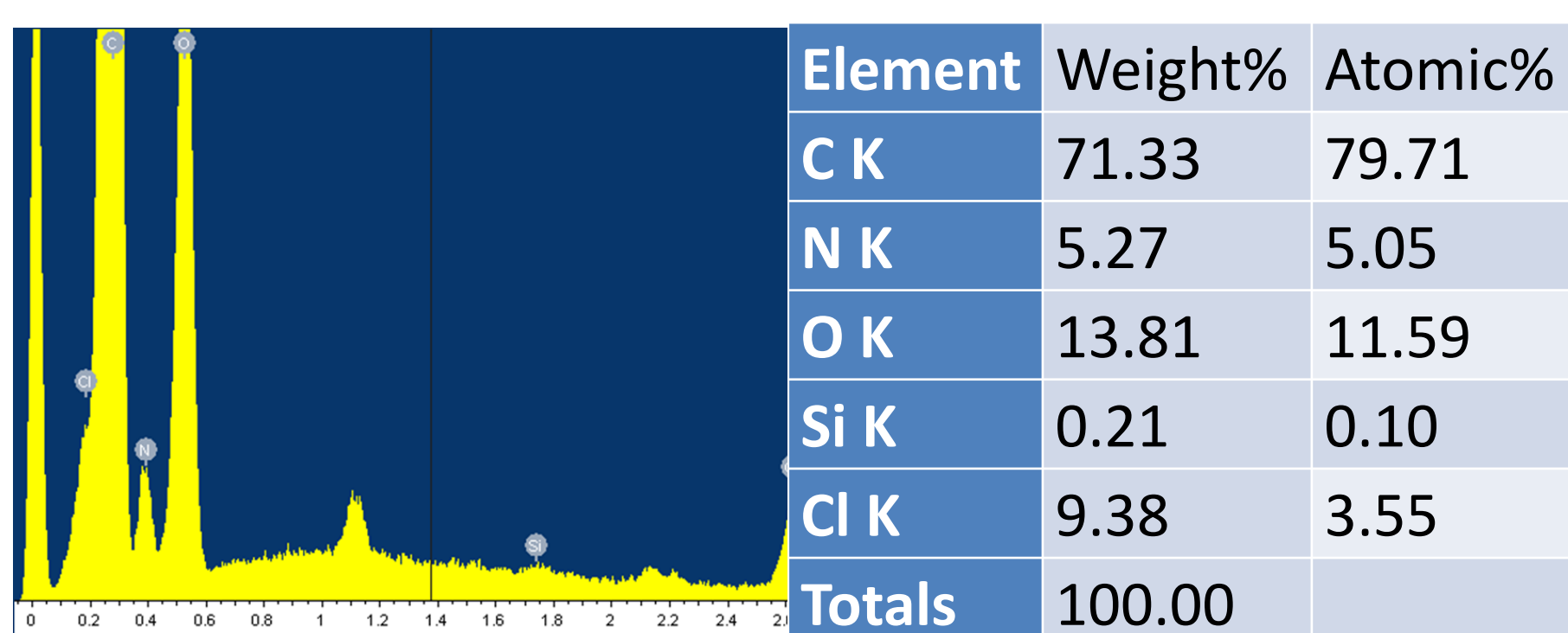
- To explore the influence of internal microstructures of Poly(lactic-co-glycolic acid) microspheres on drug release with high resolution imaging and image-based analytics.
- Effective diffusivity of drug release is calculated and release profile is predicted with a image-based numerical simulation method.

## Methods

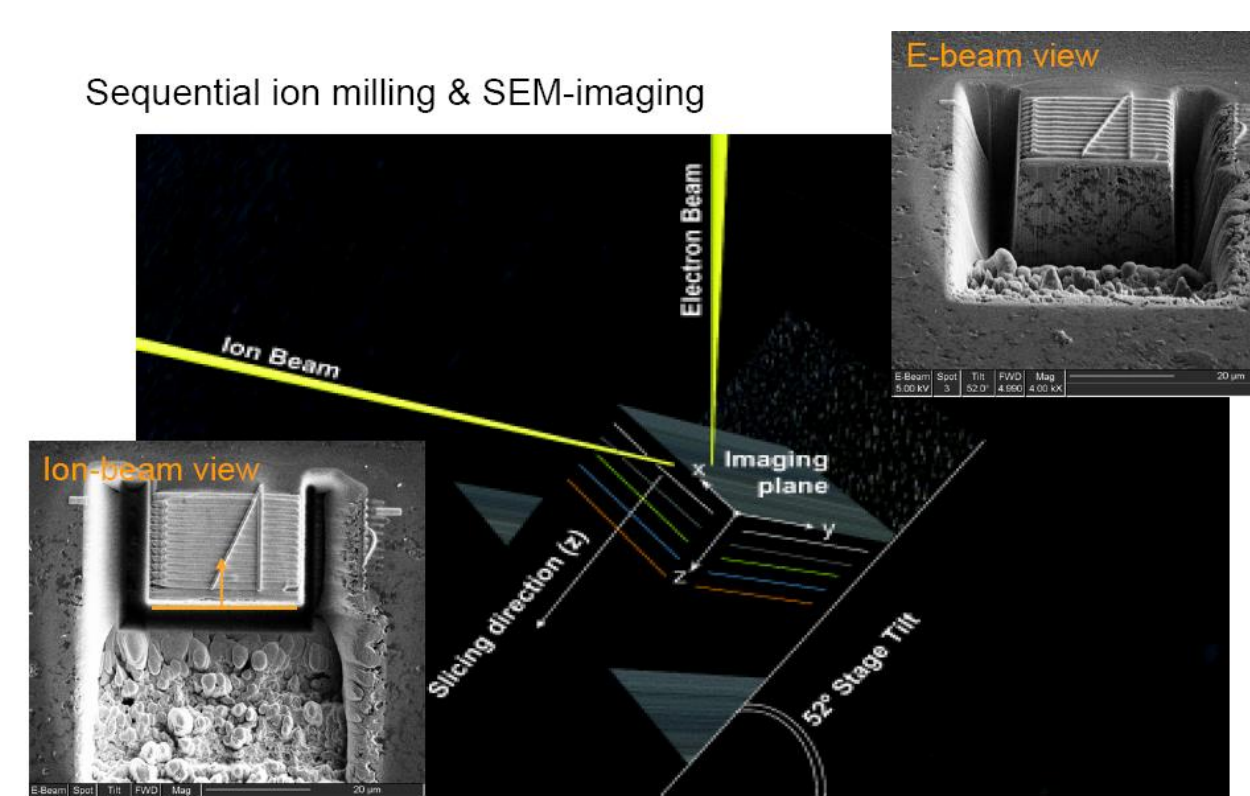
- Focused ion beam scanning electron microscopy (FIB-SEM)
- Energy dispersion X-Ray spectroscopy (EDS)
- Image analytics with artificial intelligence
- Image-based release profile prediction



FIB-SEM Cross Section and Primary Feature Identification



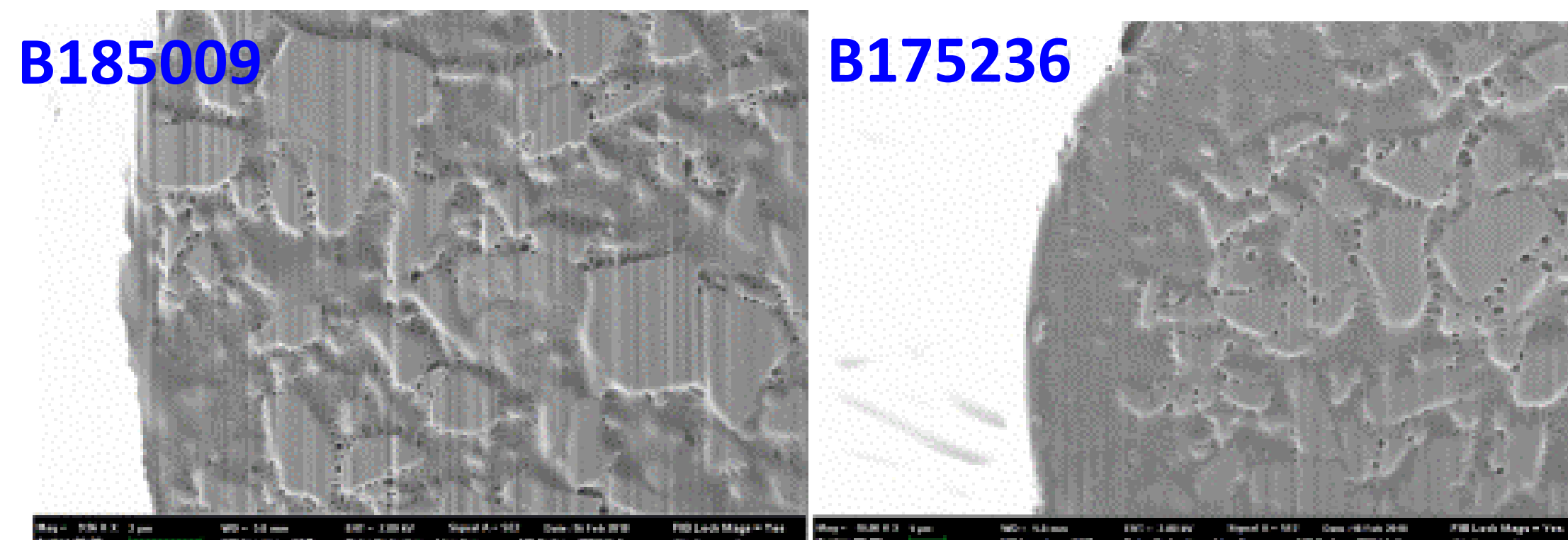
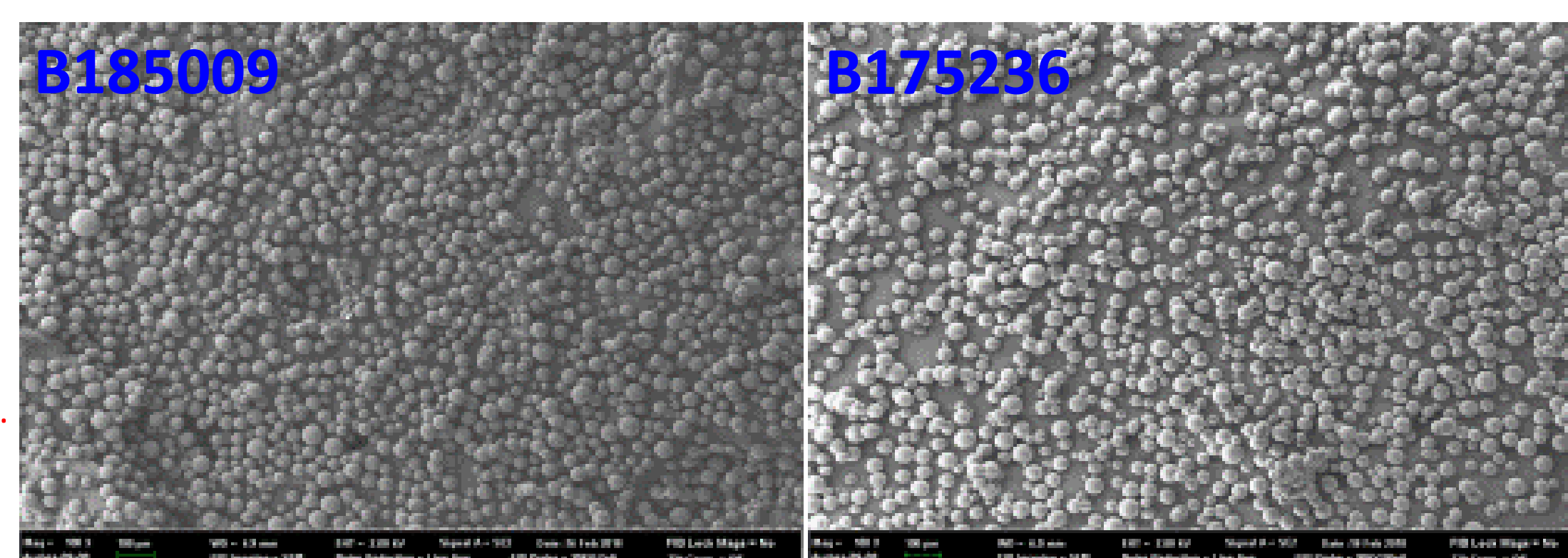
Representative EDS Analysis



FIB-SEM Principle

	Laser	Image
D <sub>10</sub>	0.5	0.7
D <sub>50</sub>	1.6	1.7
D <sub>90</sub>	4.3	3.3

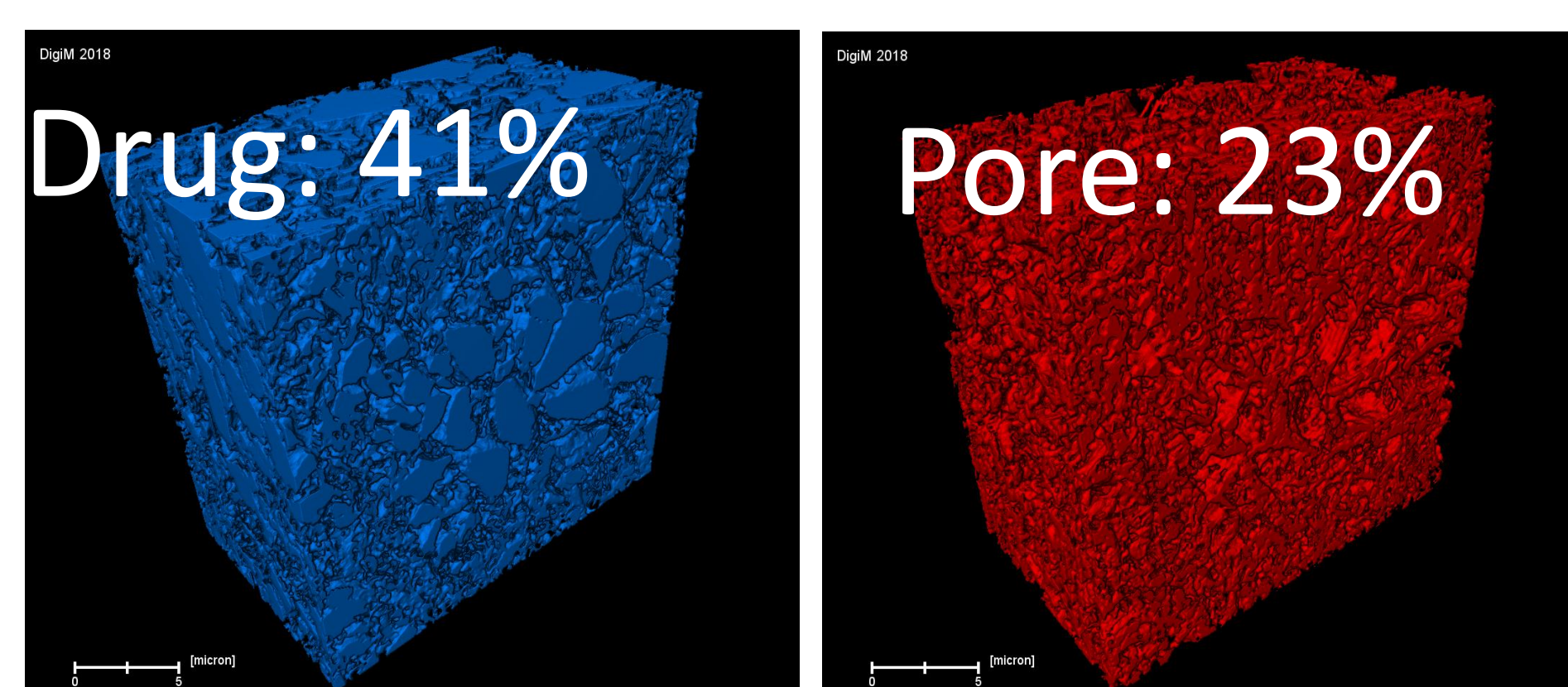
PSD Comparison



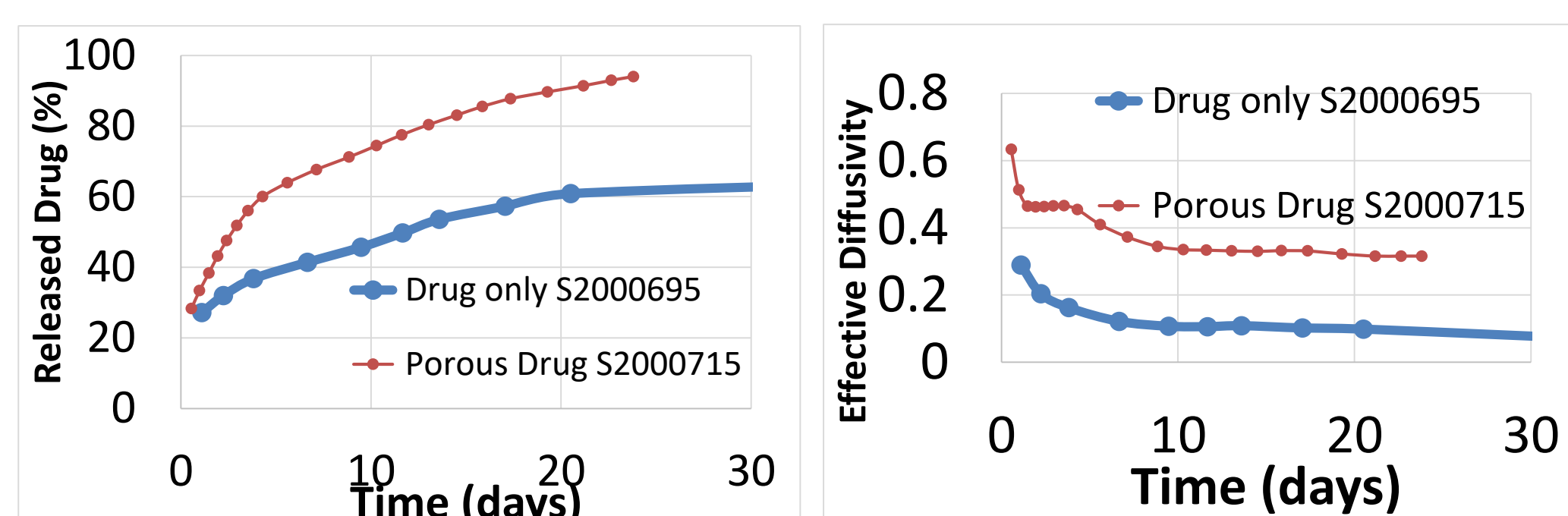
FIB-SEM comparison on two samples with different release rate.

## Results and Conclusion

- EDS analysis (surface and cross section) confirms drug distribution, and reveals existence of residue solvents.
- 2D FIB-SEM cross section analysis quantifies porosity, pore morphology, and pore size distributions as well as drug particle size and distributions. Drug particle distribution is reconstructed and compared well with raw drug material before formulation.
- The initial release rate of B185009 is 40% higher than B175236. Cross section by FEB-SEM shows API is much more closer to microsphere surface.
- The simulation reveals that the merge of nanopores over time increases the connections between pores and thus increase the release rate of drug.



3D Reconstructed Drug and Porosity Volume



Drug controlled release profile.

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