

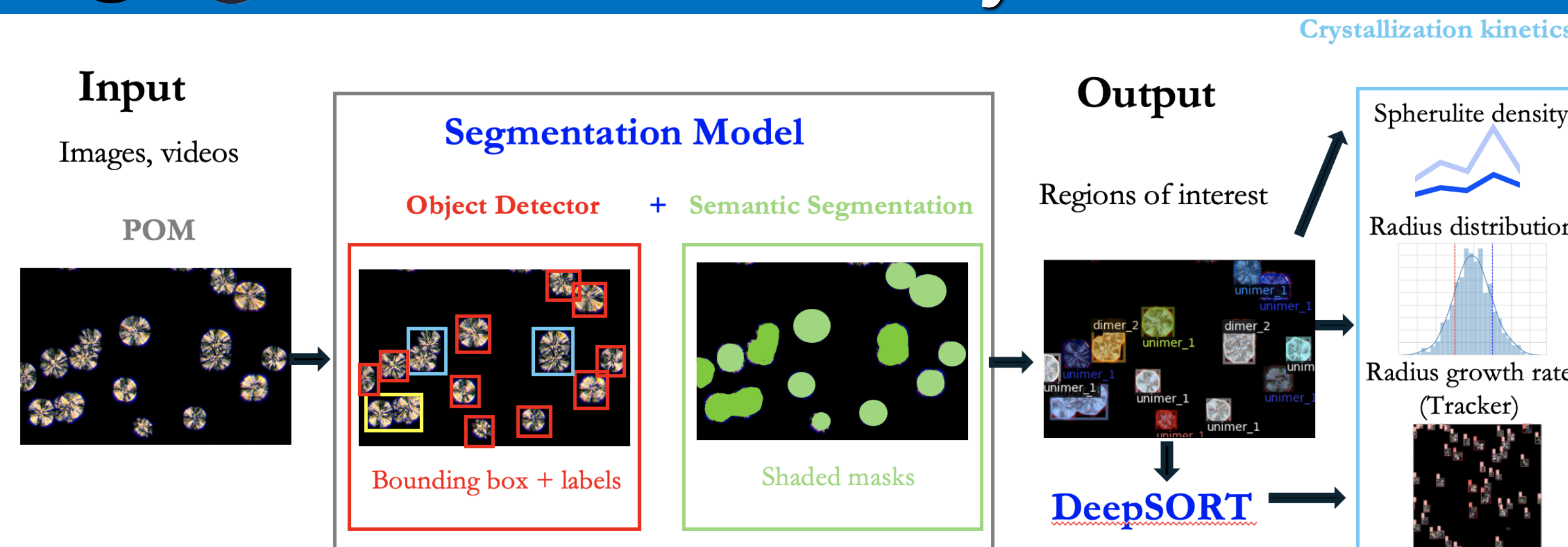
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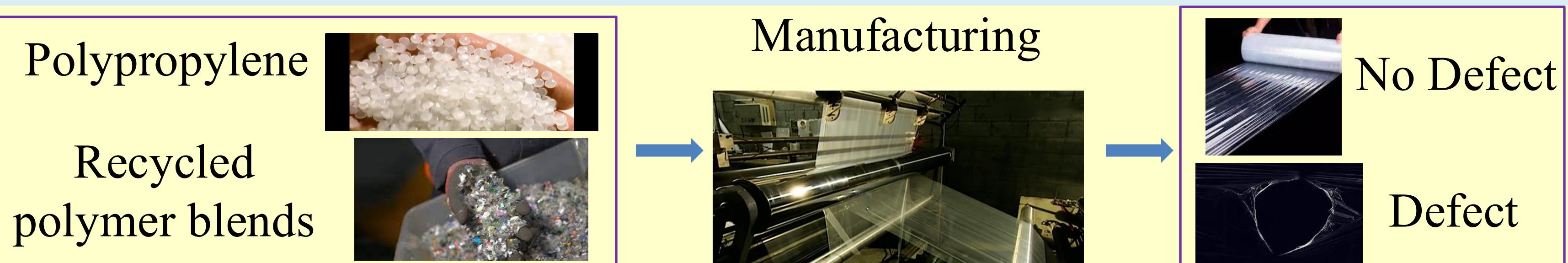
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1 Summary



We replace the classical tedious manual labor with a few-shot learning data-driven model by a combination of deep learning-based segmentation and object tracking. We first input our annotated data to a pretrained deep learning model and fine tune it for instance segmentation. We then extract physical insights from the output masks, such as number and size of the shaded masks and their distribution. We further use a tracker based on DeepSORT algorithm to track the change of shaded masks of each instance across different frames.

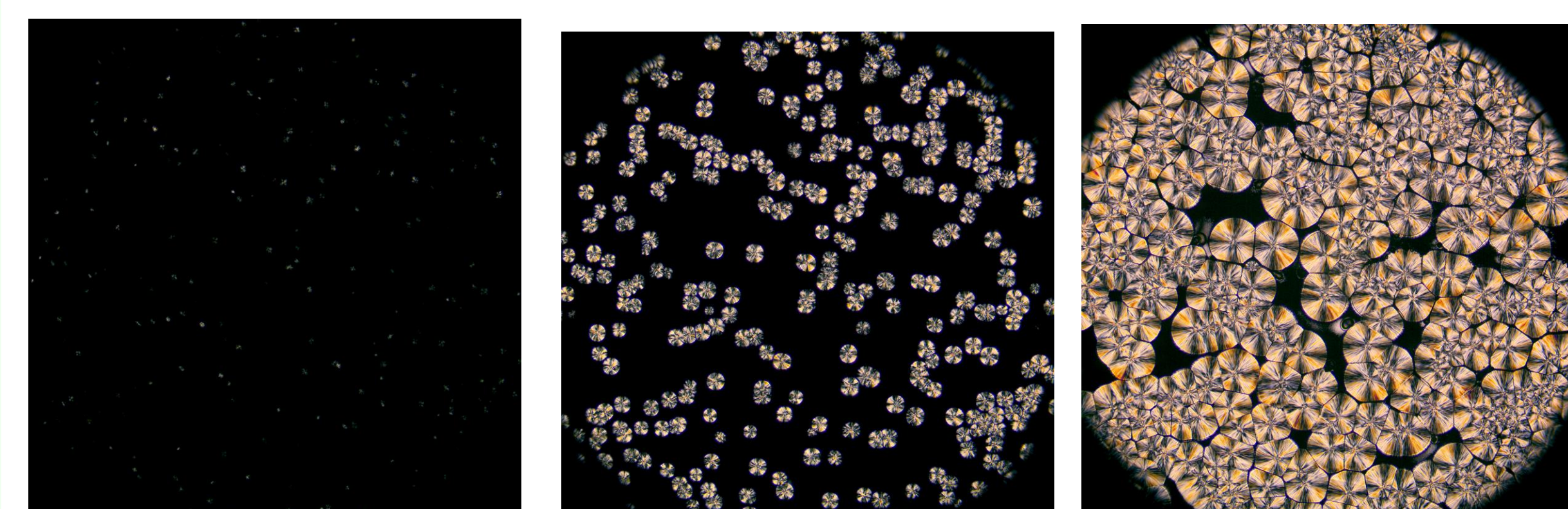
2 Background



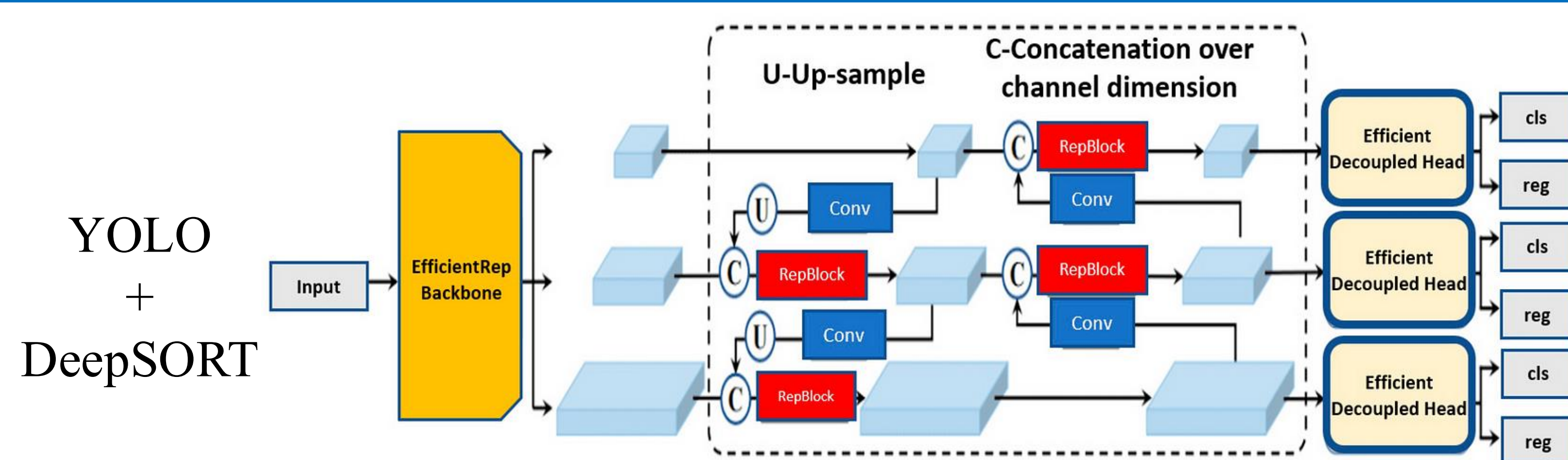
3 Problem

Understanding the crystallization kinetics of homopolymers is important for the design and manufacturing of recycled polymers with targeted properties for a wide range of applications.

Polarized Optical Microscopy Images of Homopolymer

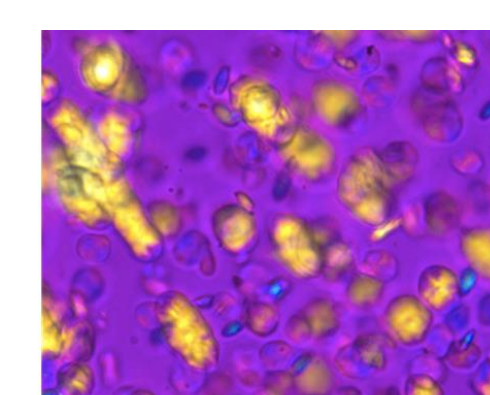
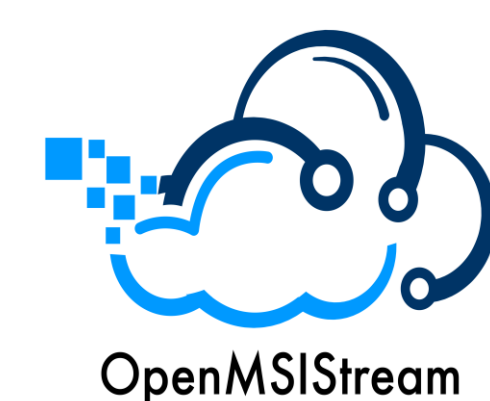


4 Method

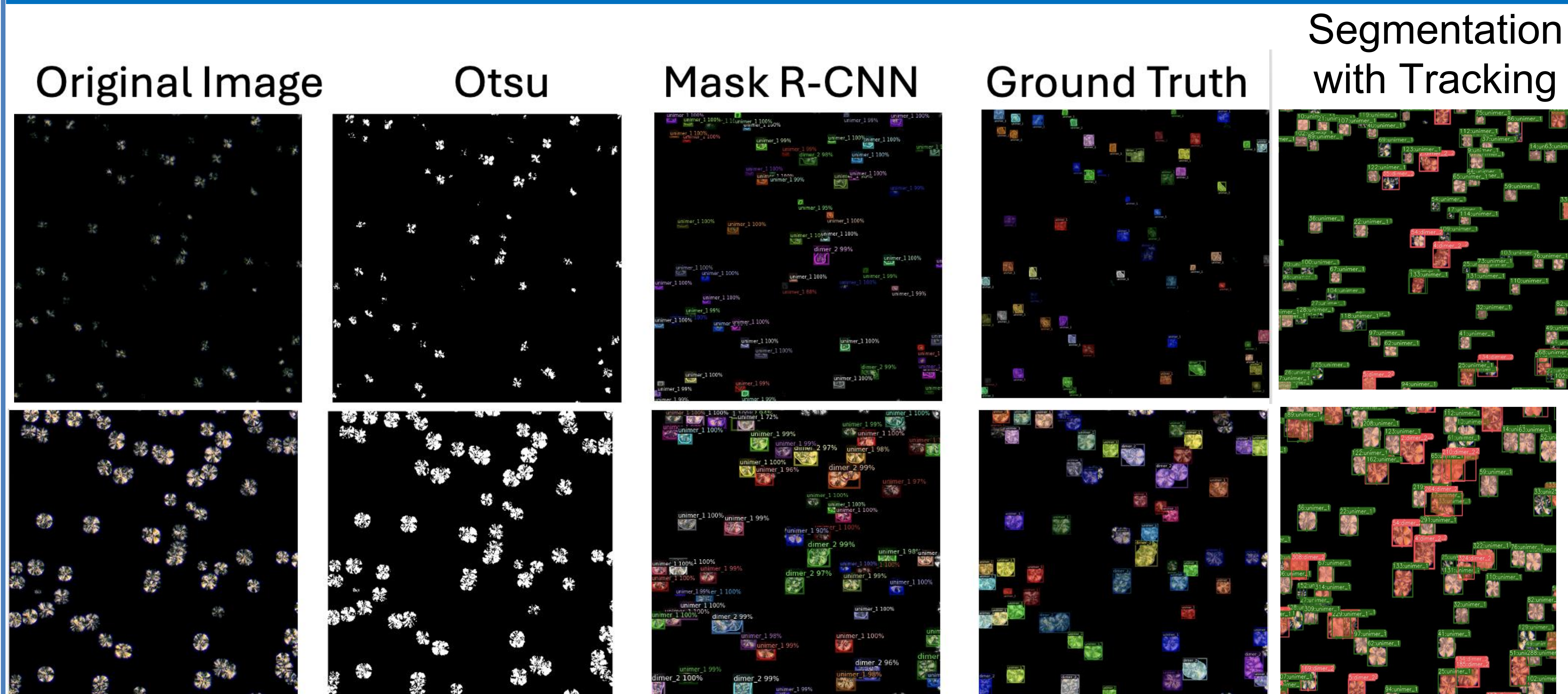


7 Future Work (Multimodal Streaming and Learning)

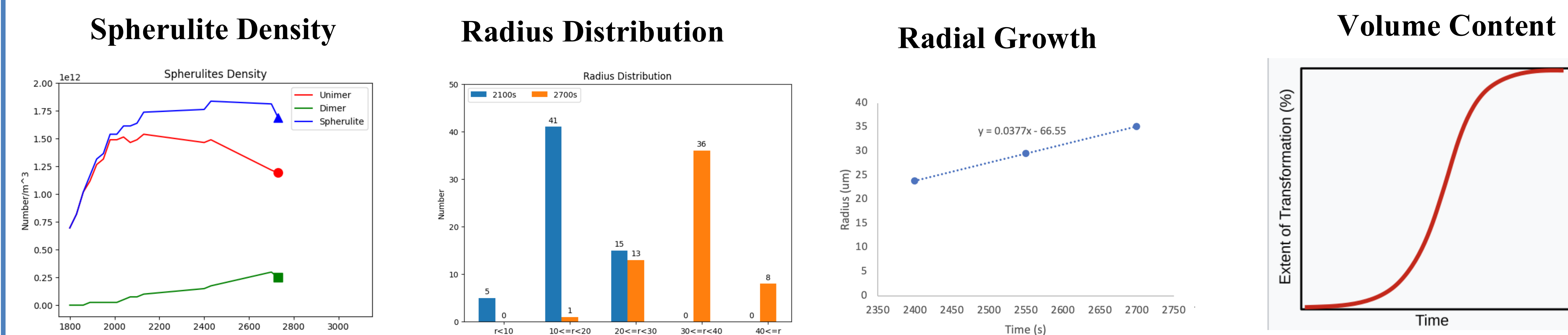
A stream processor will be integrated with the data-driven model for real-time deployment.



5 Results



6 Discussion



To determine parameters in Schneider rate equations and Avrami equation: nucleation rate $\alpha(T)$ [m⁻³ s⁻¹] and radial growth rate $G(T)$ [m s⁻¹]

Schneider Rate Equations

$$\begin{aligned} \partial_t \psi_0 &= \dot{\psi}_0|_{conv} + \dot{\psi}_0|_{pc}, \dot{\psi}_0|_{pc} := G(T)\psi_1 \\ \partial_t \psi_1 &= \dot{\psi}_1|_{conv} + \dot{\psi}_1|_{pc}, \dot{\psi}_1|_{pc} := G(T)\psi_2 \\ \partial_t \psi_2 &= \dot{\psi}_2|_{conv} + \dot{\psi}_2|_{pc}, \dot{\psi}_2|_{pc} := G(T)\psi_3 \\ \partial_t \psi_3 &= \dot{\psi}_3|_{conv} + \dot{\psi}_3|_{pc}, \dot{\psi}_3|_{pc} := 8\pi\alpha(T) \end{aligned}$$

Avrami Equation

$$Y = 1 - \exp[-K * t^n],$$

where $K = \pi\alpha(T)G(T)^3$, and $n=4$

8 Reference

Wang, G., Roberts, P., Kotula, A., Migler, K., Nguyen, T., Elbert, D., HOMOseg: Deep Learning-Based Instance Segmentation with Object Tracking for Crystallization Kinetics of Homopolymer in Dilute Phase (To be Submitted)