

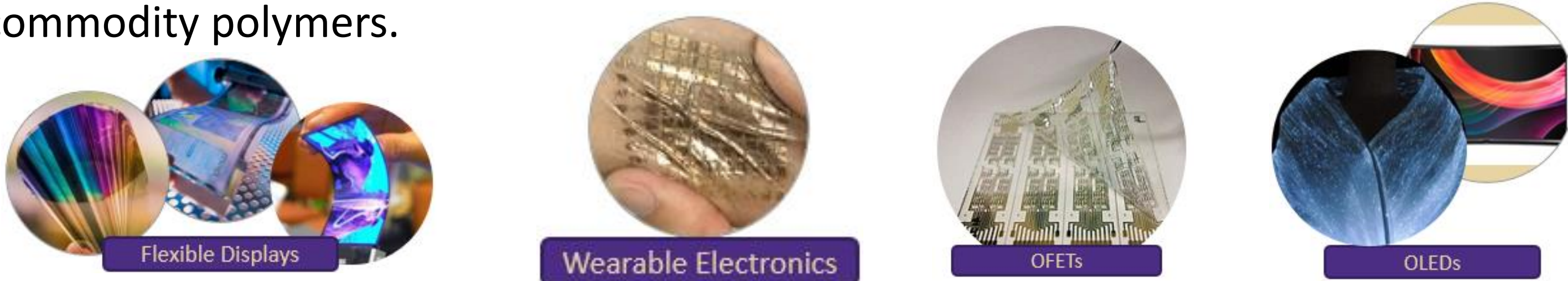


## Abstract

Blends of conjugated and commodity polymers allow for a refinable balance between the conjugated polymer's electronic properties and the commodity polymer's variable physical properties. This balance is vital in organic electronics such as electronic skin or haptics, which require increased flexibility and durability, while still maintaining high electronic performance. Understanding the fundamental interactions between conjugated polymers and commodity matrix polymers is essential for designing and optimizing organic electronic devices. Previous research using conjugated polymer blends has shown a strong relationship between the morphology of the blends, with consideration of degree of phase separation and degree of crystallization, and the resulting electronic properties. Using X-ray scattering, we examine the phase separated structure of an elastomeric tri-block matrix polymer as well as changes in the spacing and structure that occur with the addition of a conjugated polymer. When these films were analyzed, a significant shift in the characteristic peaks of the tri-block was observed, indicating that the addition of the conjugated polymer forced the swelling of the tri-block's phase-separated lattice structure. Experiments are being conducted to determine the extent of swelling and the final conformation of these films. The goal of this work is to develop a schematic for the phase separation of elastomeric tri-block based polymer blends, focusing on the morphological and electronic impact of the addition of conjugated polymers on the existing structure of elastomeric tri-blocks

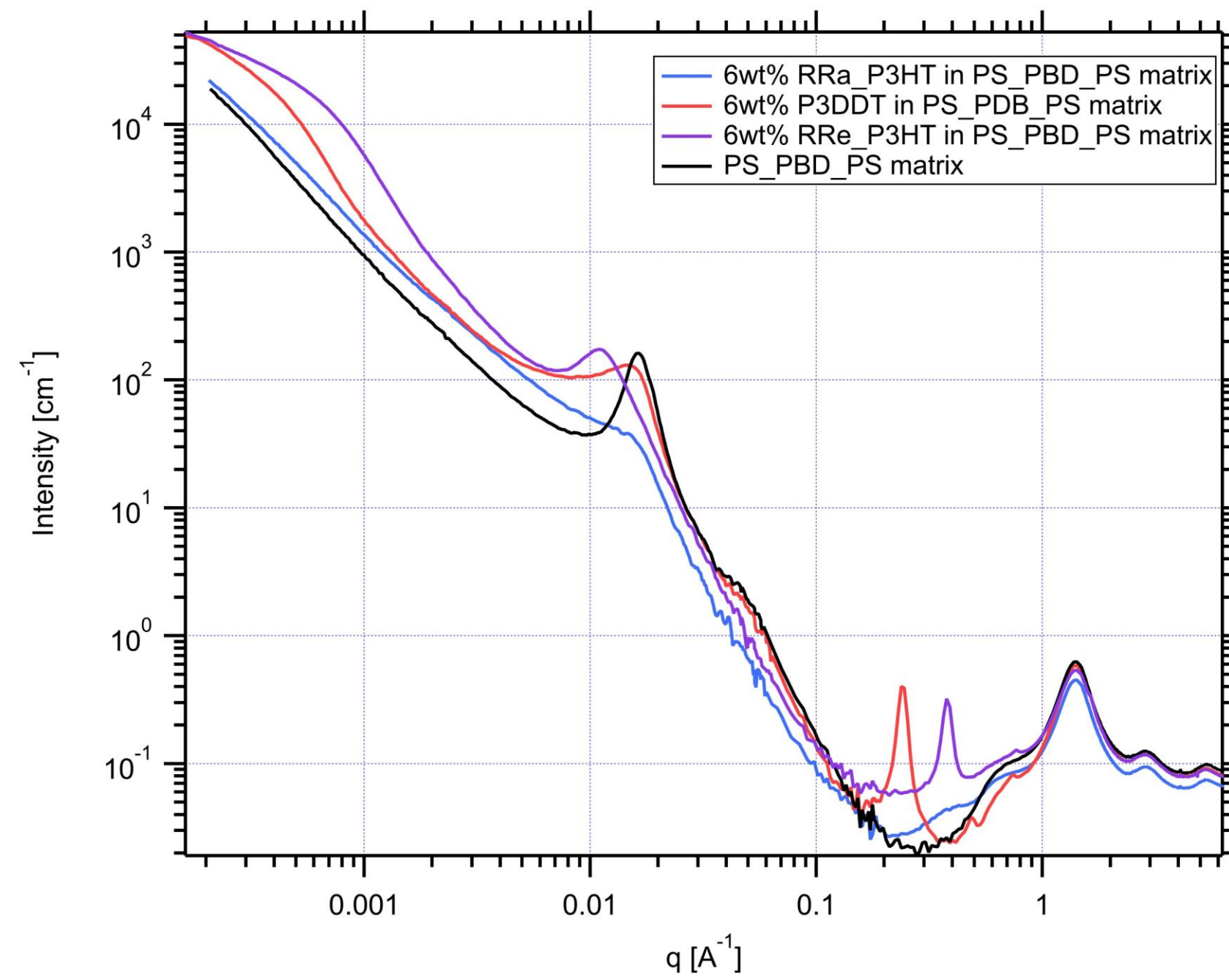
## Introduction

- Conjugated Polymers (CPs) enable low-cost, flexible and lightweight alternatives to traditional devices and elastomers can expand into even more malleable solutions
- Previous research in explored blends of CP's and commodity polymers show increased stability<sup>[1]</sup>, conductivity<sup>[2]</sup>, and workability<sup>[3]</sup> of the blend over pure CP or commodity polymers.



## Elastomeric Triblock Investigations

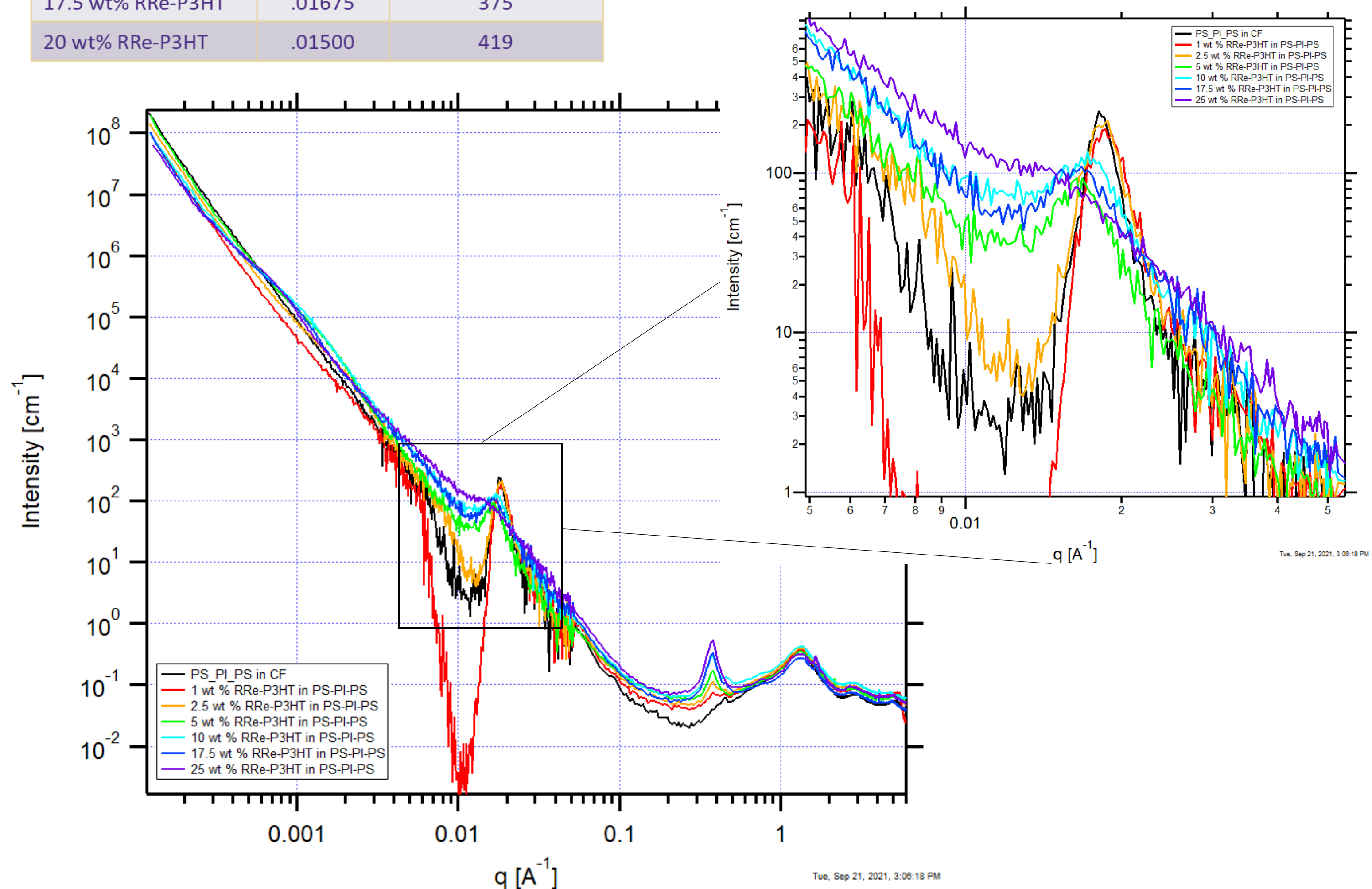
	q Peak	Size (Angstroms)
RRe-P3HT	.010931	575
RRa-P3HT	.012961	485
P3DDT	.016079	391
PS_PBD_PS	.016229	387



- As conjugated polymer is added to the PS-PBD-PI elastomeric triblock, the correlation peak of the PBD block changes.
  - RRe-P3HT: observable shift to low q
  - RRa-P3HT: peak flattens out without a shift in q
  - RRe\_P3DT: slight shift to low q and slight drop in peak height

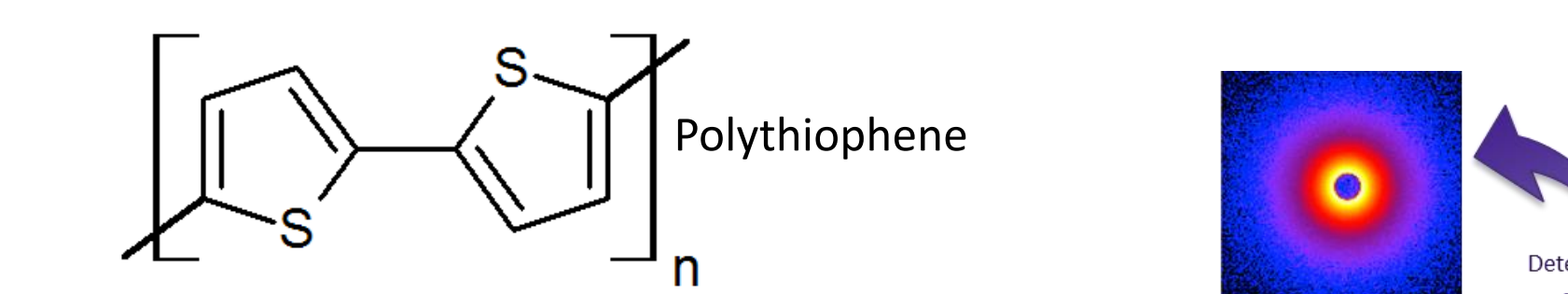
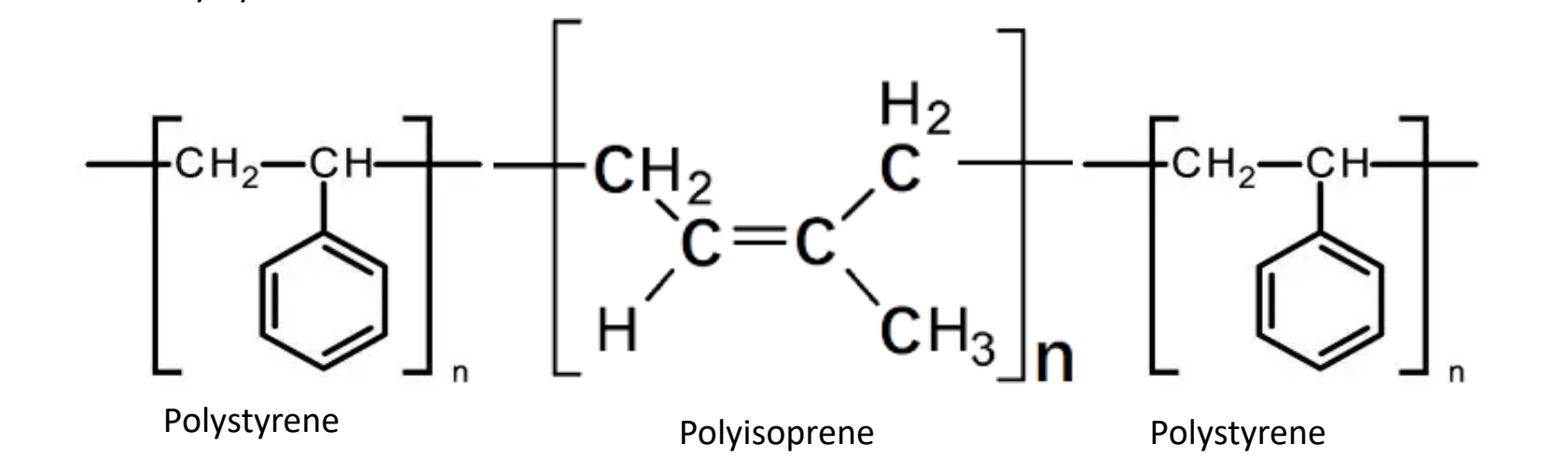
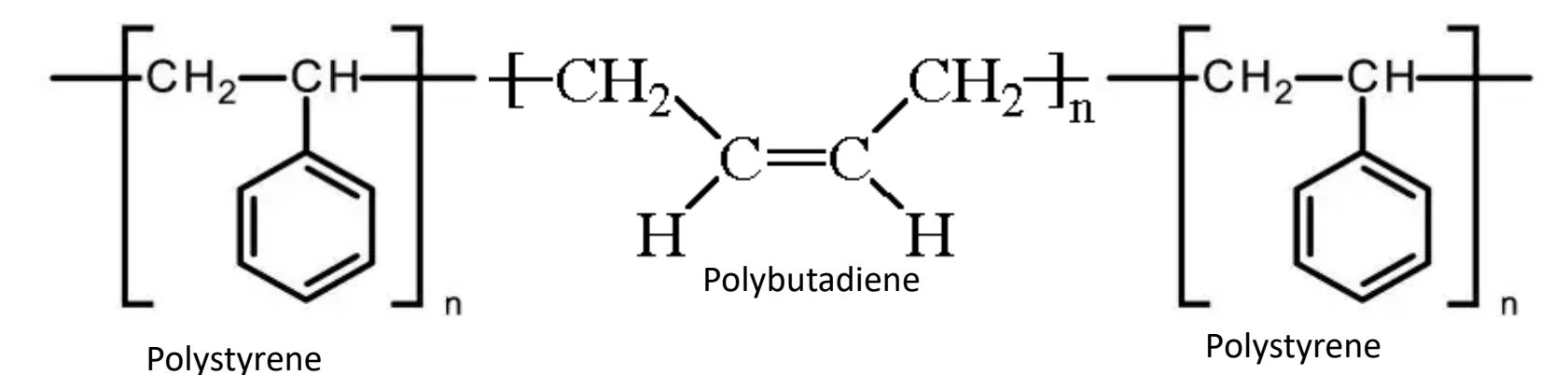
	q Peak	Size (Angstroms)
PS-PI-PS	.01845	340
1 wt% RRe-P3HT	.01852	339
2.5 wt% RRe-P3HT	.01863	337
5 wt% RRe-P3HT	.01673	375
10 wt% RRe-P3HT	.01707	367
17.5 wt% RRe-P3HT	.01675	375
20 wt% RRe-P3HT	.01500	419

- Peak changes also occur with increasing amounts of a single conjugated polymer
- Peaks widen and shift towards low q – indicating larger lattice spacing as well as less defined lattice structure



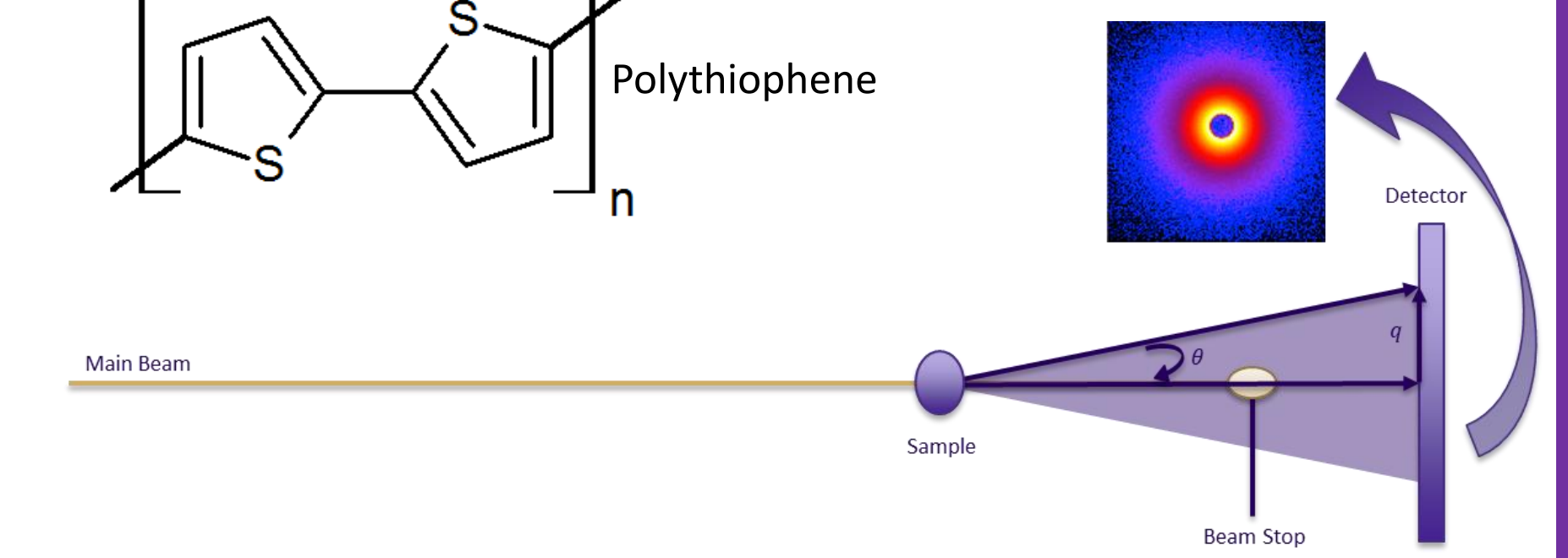
## Materials and Methods

- Previously explored conjugated polymers were used alongside ABA triblock polymers with a rubbery B block and glassy A blocks, allowing for elastomeric crosslinking in the bulk
- X-Ray scattering was used to probe the conformation of these blends, allowing for investigation of the matrix polymer's structure



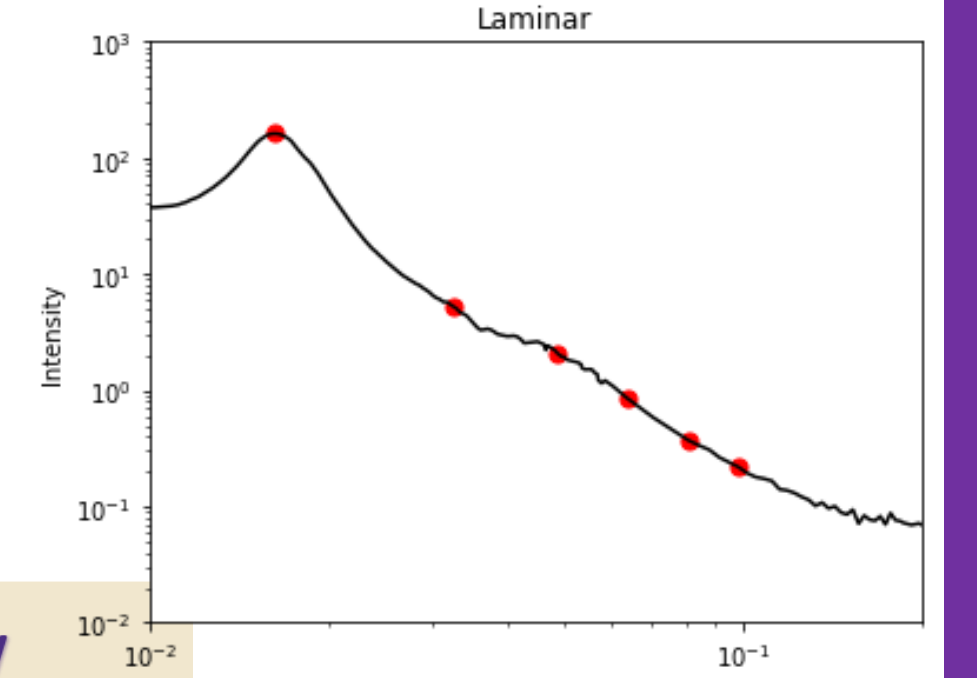
$$I(q) = n \Delta\rho^2 V^2 P(q) S(q) + \text{background}$$

Scattering length density difference  
 Form factor: includes information about particle shapes  
 Number density of particles  
 Volume of particles  
 Structure factor: includes information about particle-particle correlations



## Peak Indexing and Analysis

- Peaks signal repeating structures within the sample, and with use of known Bragg reflections for various structures, repeating structures can be identified.
- Peak locations indicates how large the spacing in the structure is in the sample
- Peak sharpness indicates how divided are the layers



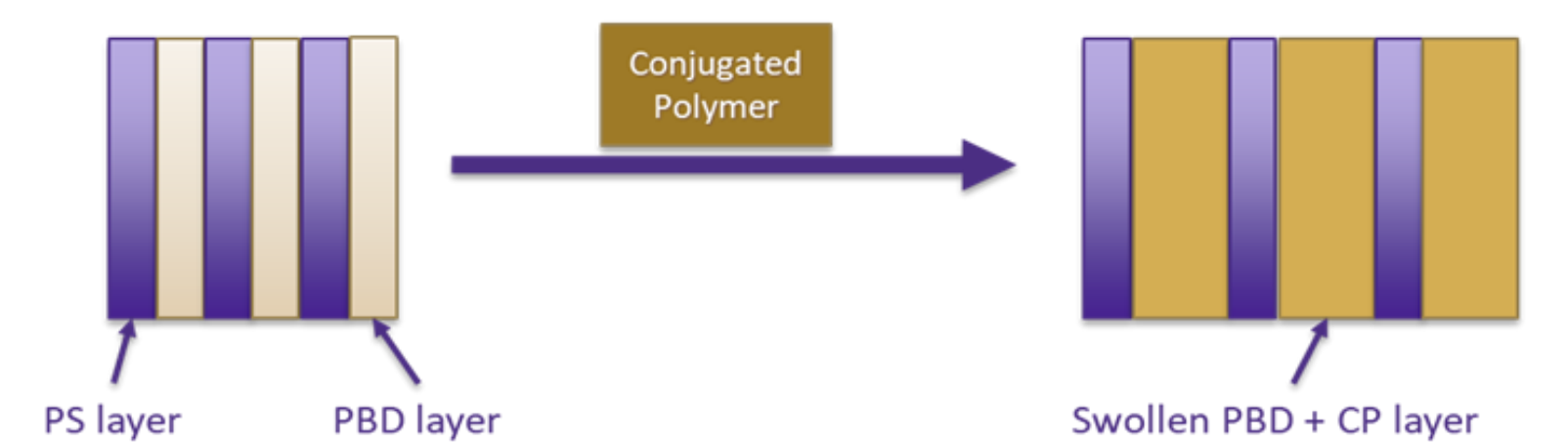
### Bragg's Law

$$n\lambda = 2d\sin\theta$$

$\lambda$  = wavelength  
 $d$  = lattice spacing  
 $\theta$  = angle of incidence

## Conclusions

- The conjugated polymer is interacting with the matrix polymer in a way that changes the assembly of the matrix polymer
- Interactions occur with the elastomeric triblock specifically – known interactions of conjugated polymers and polystyrene do not display this change



## References

- [1] Kumar, A.; Baklar, M. A.; Scott, K.; Kreouzis, T.; Stingelin-Stutzmann, N. *Adv. Mater.* **2009**, *21* (44), 4447–4451.
- [2] Qiu, L.; Wang, X.; Lee, W. H.; Lim, J. A.; Kim, J. S.; Kwak, D.; Cho, K. *Chem. Mater.* **2009**, *21* (19), 4380–4386.
- [3] Selivanova, M.; Chuang, C.-H.; Billet, B.; Malik, A.; Xiang, P.; Landry, E.; Chiu, Y.-C.; Rondeau-Gagné, S. *ACS Appl. Mater. Interfaces* **2019**, *11* (13), 12723–12732

## Acknowledgements

