

Introduction

Organic semiconductors (OSC) have several advantages over inorganic counterparts such as strong emission, easy processing, low cost, high resistance to photobleaching, and excellent resistance to a wide range of PH, temperatures, and solvents [1,2]. Although the idea of using sweat pores to detect latent fingerprints of human hand has been reported, the cheap, fast, and reliable pore mapping are always more desirable. Latent prints often remain onto the surface of various objects as random impressions and identification of those fingerprints plays important role in criminal investigation due to its uniqueness to individual's fingerprint ridges. In this work, we used OSC nanoparticles as agents for developing and detecting latent fingerprints [2,3] in forensics. The fingerprints were collected on substrate from donor's fingers rubbed in oily parts of the body.

Abstract

Traditionally, molybdenum disulfide-based method is being used for the development of latent fingerprints. Here we used polymer nanoparticles for developing and detecting latent fingerprints on non-porous surfaces. Polymers as fluorescent materials have several advantages over inorganic counterparts such as strong emission, easy processing, and low cost. In this work, Poly(3-hexylthiophene) (P3HT) nanoparticles were prepared through phase separation method. The resulting nanoparticles were used to develop the fingerprints on different substrates and characterized using Raman spectroscopy.

Materials

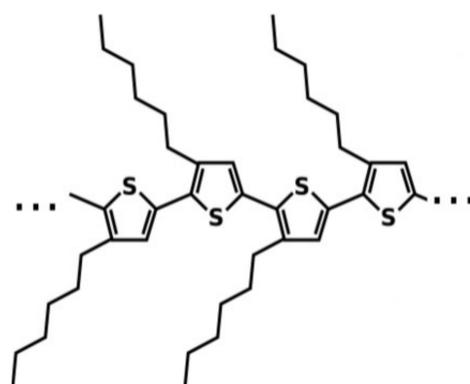


Figure 1. Chemical structure of P3HT Polymer

Nanoparticle Synthesis

P3HT polymer was purchased from 1-Materials. P3HT solution (10 mg/mL) was prepared in chlorobenzene and stirred overnight. The 1 ml solution of P3HT was then added slowly to a 10 ml of ethanol dropwise under stirring. The solution is stirred continuously for 2 hours. The solution is then tip sonicated for 10 minutes and centrifuged at 4500 rpm for five minutes to separate the particles. The resulting solution was left in hood for 24 hours to dry.

Optical Images of P3HT Nanoparticles

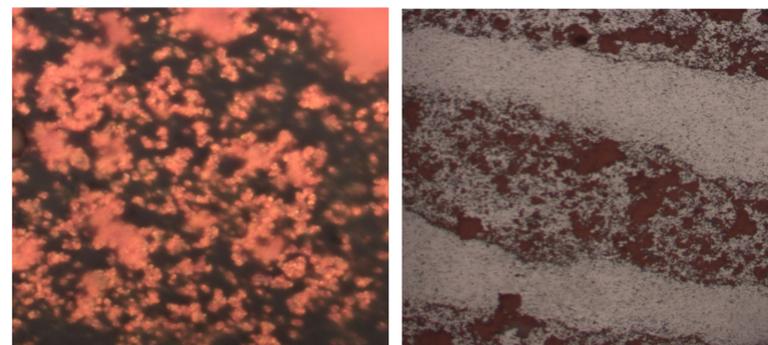


Figure 2. Images of fingerprints taken at 100X (left) and 10X (right). Image sizes are 35 μm x 35 μm (left) and 350 μm x 350 μm (right)

Raman Data

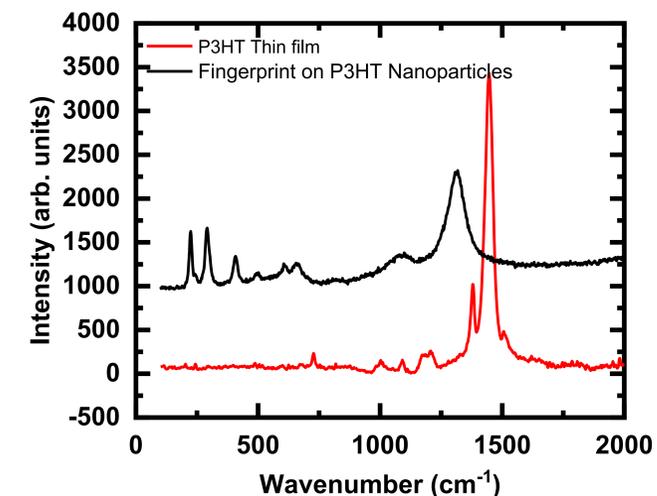


Figure 3. Raman scattering of P3HT film and fingerprint on P3HT nanoparticles

Summary

- We successfully synthesized P3HT polymer nanoparticles. The size of nanoparticles was probed using optical microscope.
- Raman spectroscopy data shows the clear signature of urea (1310 cm^{-1} peak), and amino acids and proteins (1062, 662 cm^{-1} peaks).
- Raman spectroscopy which requires a small amount of sample, being non-destructive, and very substance specific, is an ideal tool for analyzing crime scene evidence.

Acknowledgements

This work was supported by NSF RIA program HRD 1900998. Also, authors would like to thank NSF "Targeted Infusion Grant: Providing Opportunities to Minority Students in STEM (*PrOMiSS*) Grant proposal 1719511.

References

1. V. Causin, *Analytical Methods* **2**, 792-804 (2010).
2. H. Chen, R. Ma, Y. Chen, and L. Fan, *ACS applied materials & interfaces* **9**, 4908-4915 (2017).
3. H. Chen, R. Ma, Z. Fan, Y. Chen, Z. Wang, and L. Fan, *J. Colloid Interface Sci.* **528**, 200-207 (2018).