

## Experimental Supporting Information

### **Enhanced Conductivity via Extraction of Hydrocarbon Templates from Nanophase Separated PEO-LiOTf Polymer Electrolyte Films**

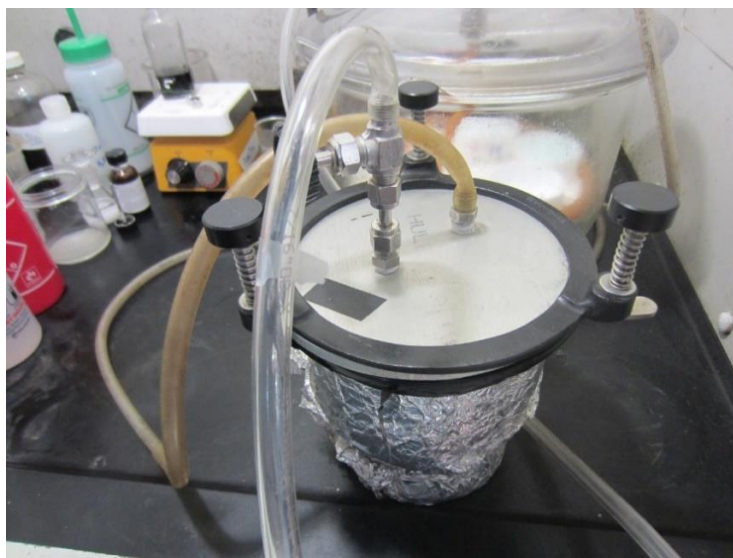
John W. Ostrander,<sup>a</sup> Lei Wang,<sup>a</sup> Teljan Ali Kizi,<sup>a</sup> Jana A. Dajani,<sup>b</sup> Austin V. Carr,<sup>a</sup> Dale Teeters,<sup>\*a</sup> and Angus A. Lamar<sup>\*a</sup>

<sup>a</sup> Department of Chemistry and Biochemistry, The University of Tulsa, 800 S. Tucker Dr., Tulsa, OK 74104, USA.

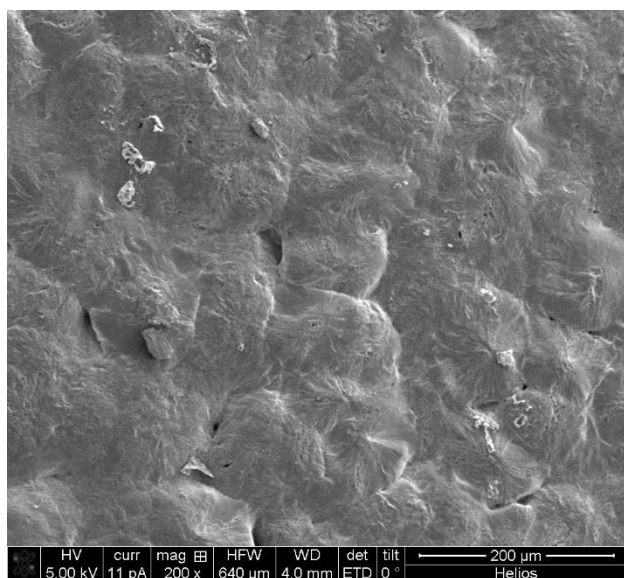
<sup>b</sup> Department of Chemistry, Hanover College, 517 Ball Drive, Hanover, IN 47243, USA.

[dale-teeters@utulsa.edu](mailto:dale-teeters@utulsa.edu) and [angus-lamar@utulsa.edu](mailto:angus-lamar@utulsa.edu)

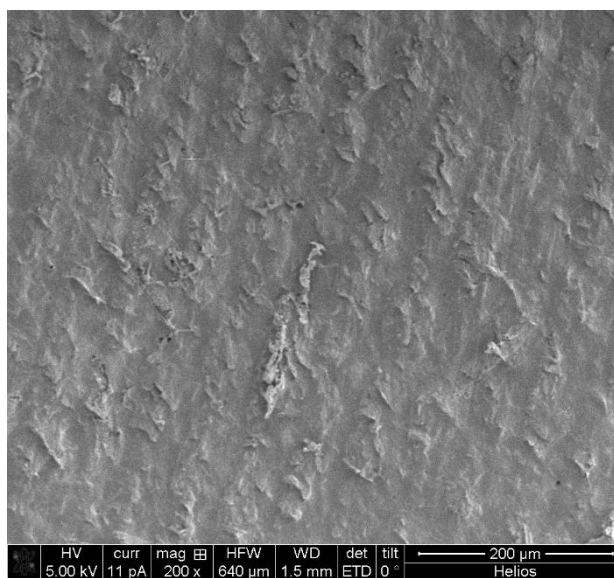
Index	Page
SEM Images of Surface Spherulites	2
SEM Images of Film Edges	3
SEM (surface of non-extracted films – “powdery”)	5
SEM (surface of non-extracted films – “aggregated islands”)	7
SEM (Dibenzothiophene - surface before and after extraction)	8
AFM Images	9
Expanded AC Impedence Plots	10
DSC Plots	15
Representative TGA Analysis	17
Images of crystallizing behavior of nanofiller compounds from acetonitrile	18



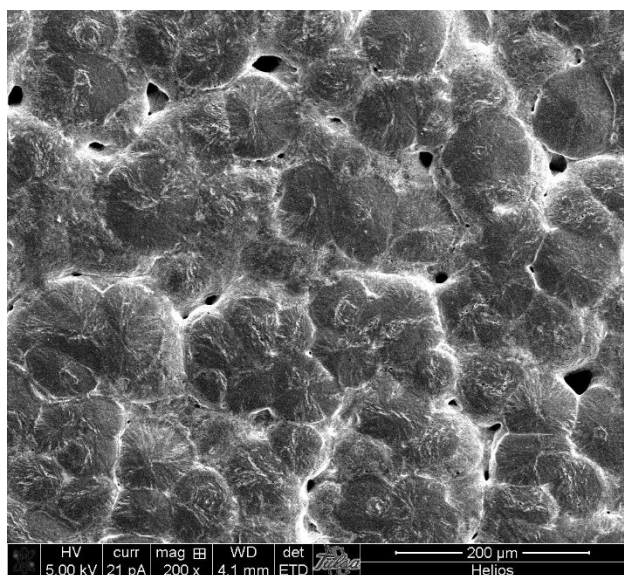
**Figure S1.** Nitrogen (flow) chamber for casting of PEO-LiOTf films. Photo taken by A. Lamar.



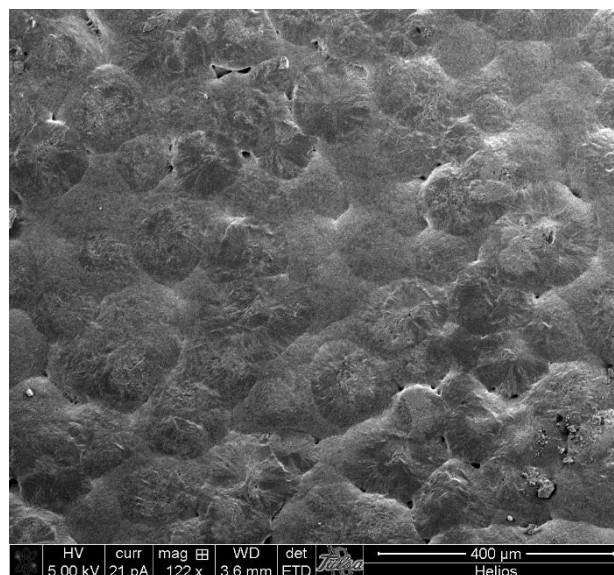
**Figure S2A**



**Figure S2B**



**Figure S2C**



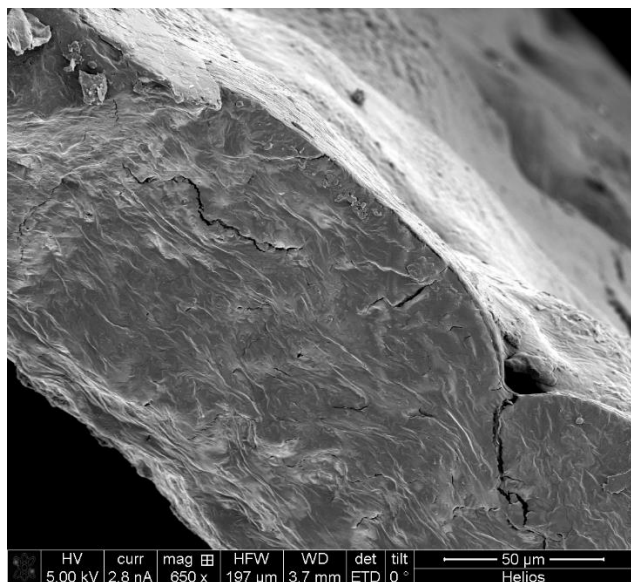
**Figure S2D**

**Figure S2A.** 20% Dibenzothiophene film **5a** (top surface) – no extraction

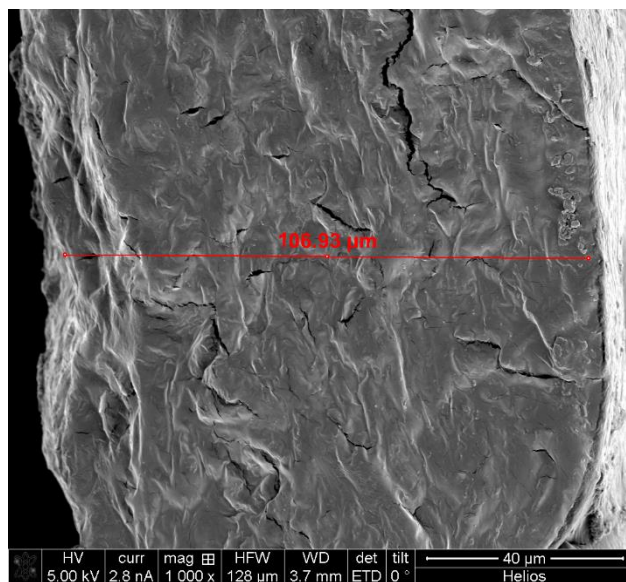
**Figure S2B.** 20% Dibenzothiophene film **5a** (bottom surface) – no extraction

**Figure S2C.** 20% Diphenylamine film **6a** (top surface) – no extraction

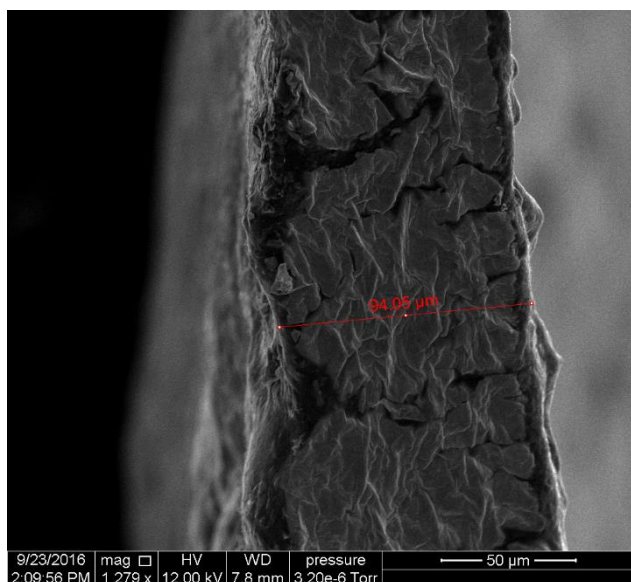
**Figure S2D.** 20% Diphenylamine film **6a** (bottom surface) – no extraction



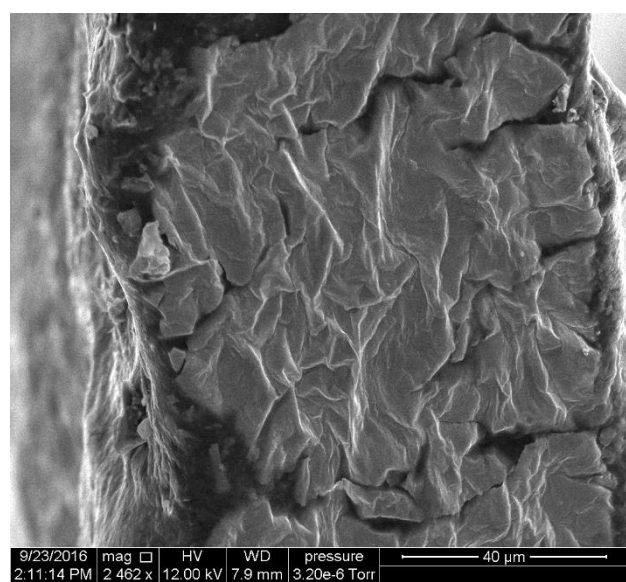
**Figure S3A**



**Figure S3B**



**Figure S3C**



**Figure S3D**

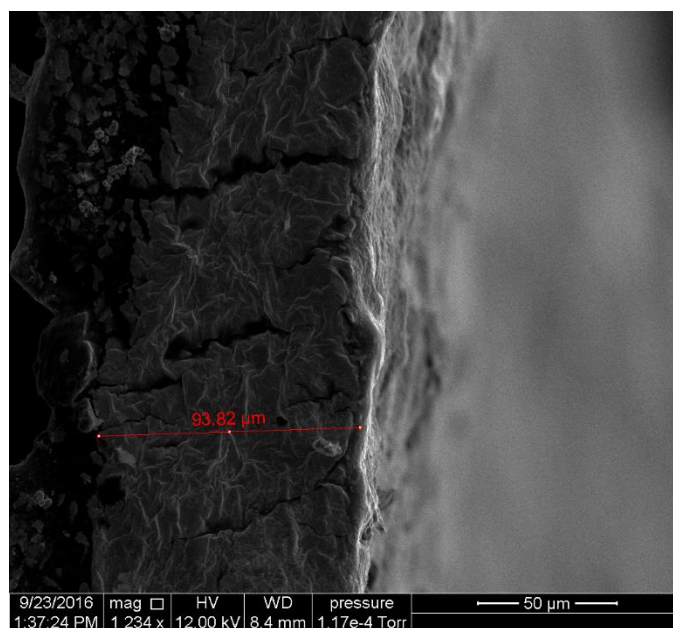
**Figure S3A.** 20% Bibenzyl film **2a** (edge) – no extraction

**Figure S3B.** 20% Bibenzyl film **2b** (edge) – after extraction

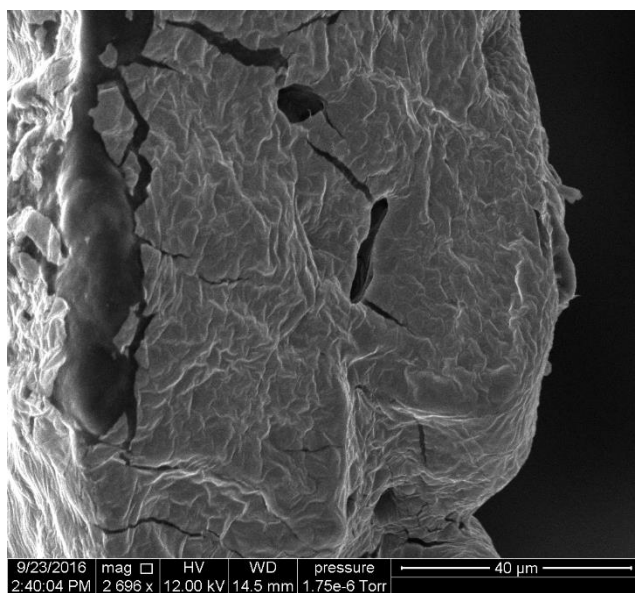
**Figure S3C.** 20% Diphenylacetylene film **3b** (edge) – after extraction

**Figure S3D.** 20% Diphenylacetylene film **3b** (edge) – after extraction (magnification of Figure S3C)

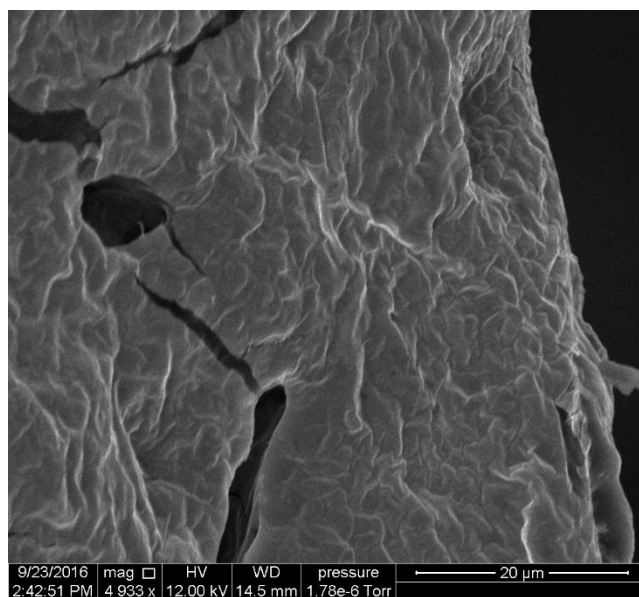




**Figure S4A**



**Figure S4B**

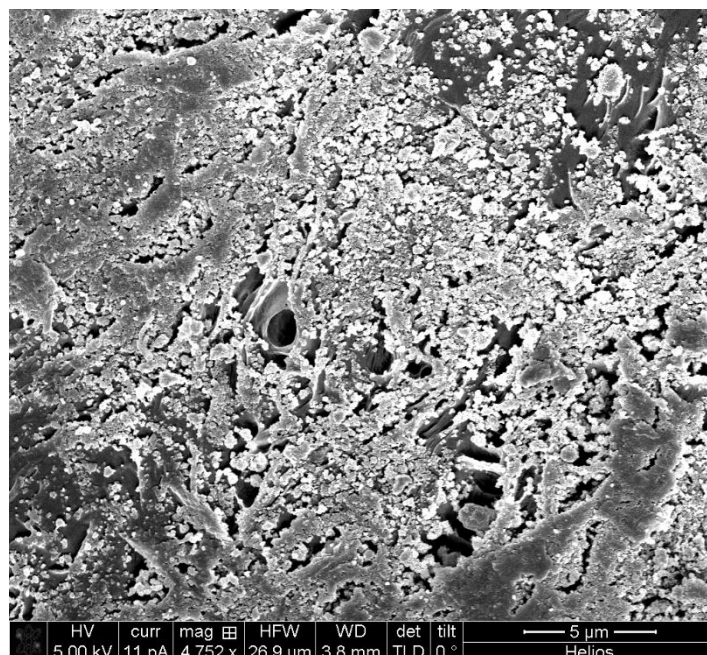


**Figure S4C**

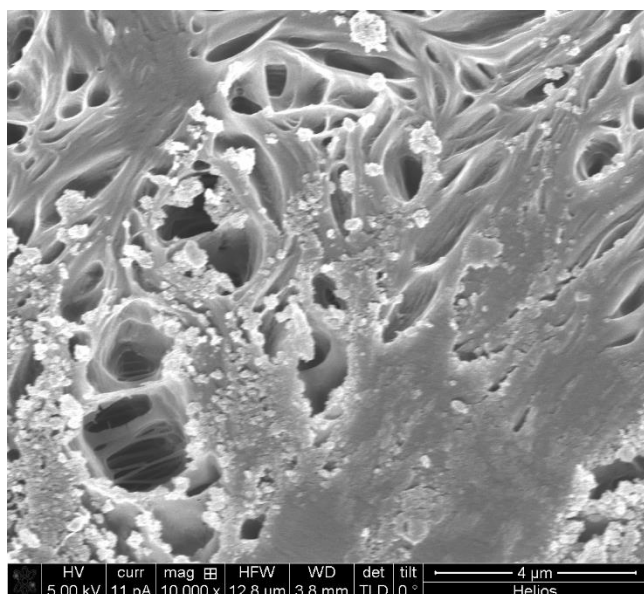
**Figure S4A.** 20% Bibenzyl film **2b** (edge) – after extraction

**Figure S4B.** 20% Fluorene film **1b** (edge) – after extraction

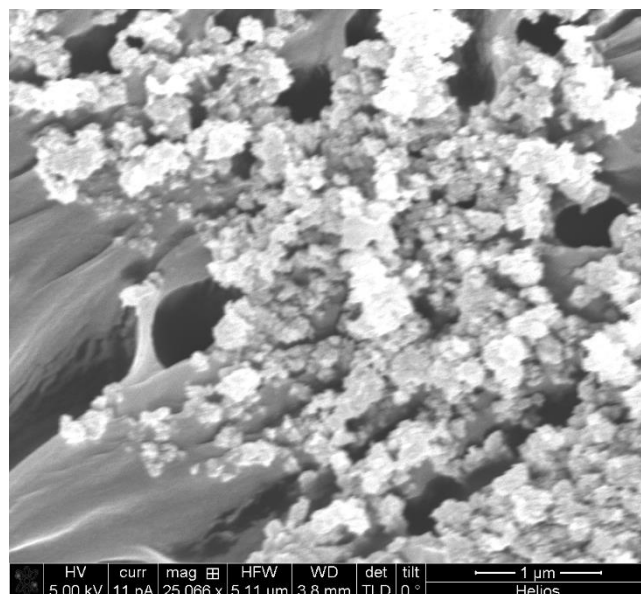
**Figure S4C.** 20% Fluorene film **1b** (edge) – after extraction (magnification of Figure S4B)



**Figure S5A**



**Figure S5B**

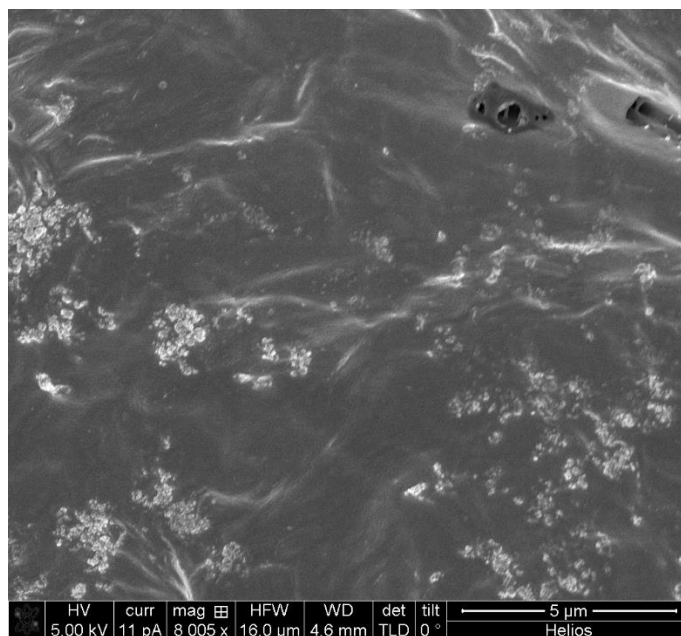


**Figure S5C**

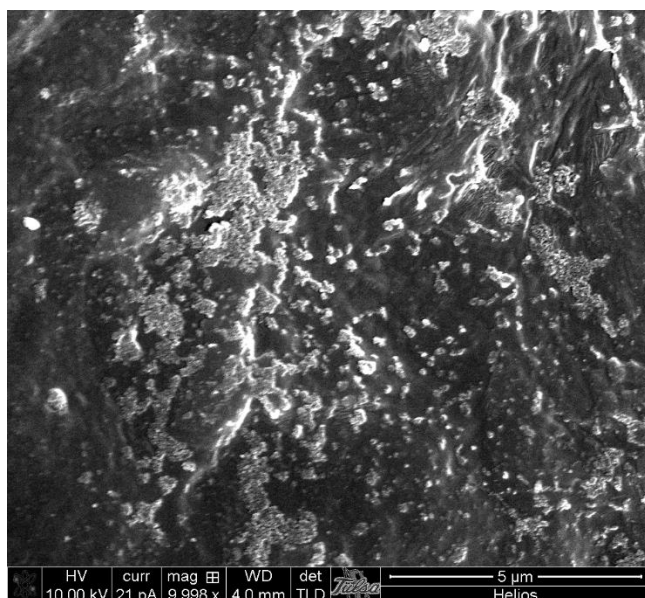
**Figure S5A.** 20% Adamantane film **4a** (bottom) – no extraction

**Figure S5B.** 20% Adamantane film **4a** (bottom) – no extraction (magnification of Figure S5A)

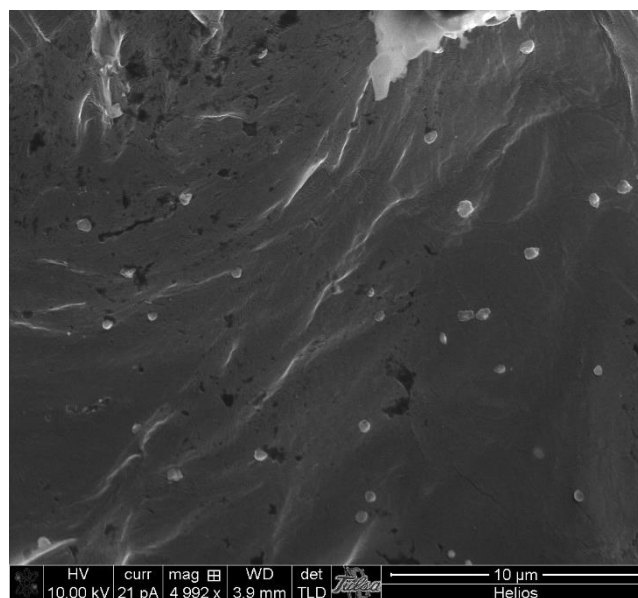
**Figure S5C.** 20% Adamantane film **4a** (bottom) – no extraction (magnification of Figure S5A)



**Figure S6A**



**Figure S6B**

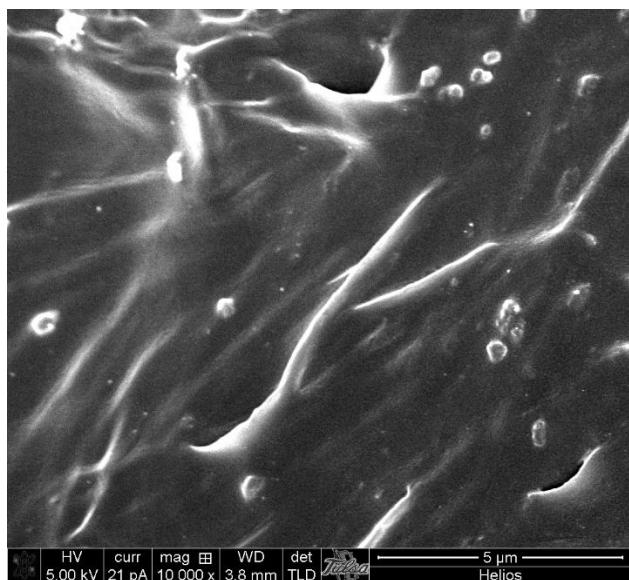


**Figure S6C**

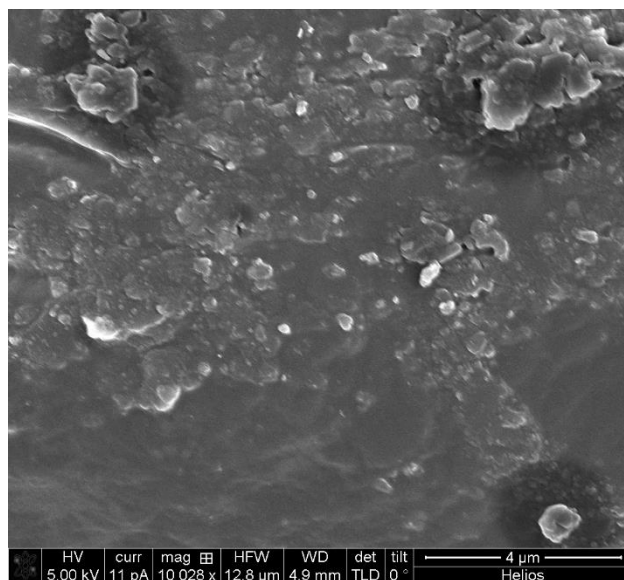
**Figure S6A.** 20% Dibenzofuran film **8a** (bottom) – no extraction

**Figure S6B.** 20% Fluorene film **1a** (bottom) – no extraction

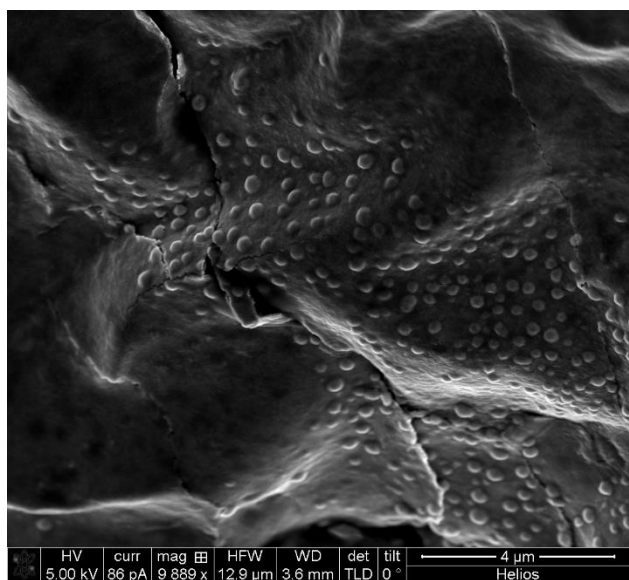
**Figure S6C.** 20% Fluorene film **1b** (bottom) – after extraction



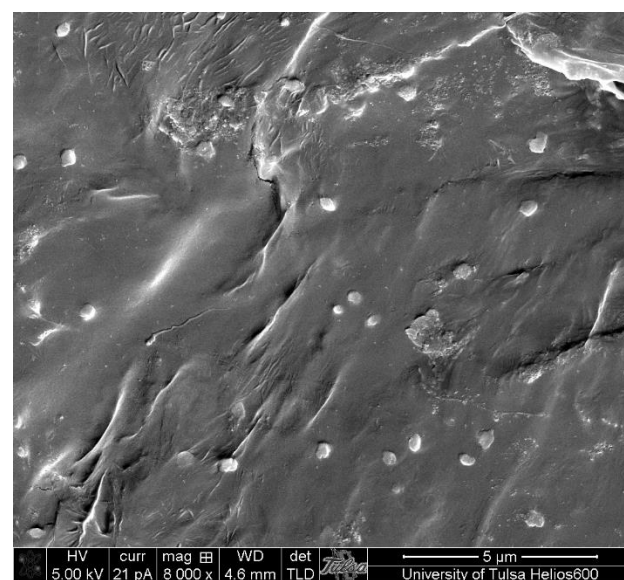
**Figure S7A**



**Figure S7B**



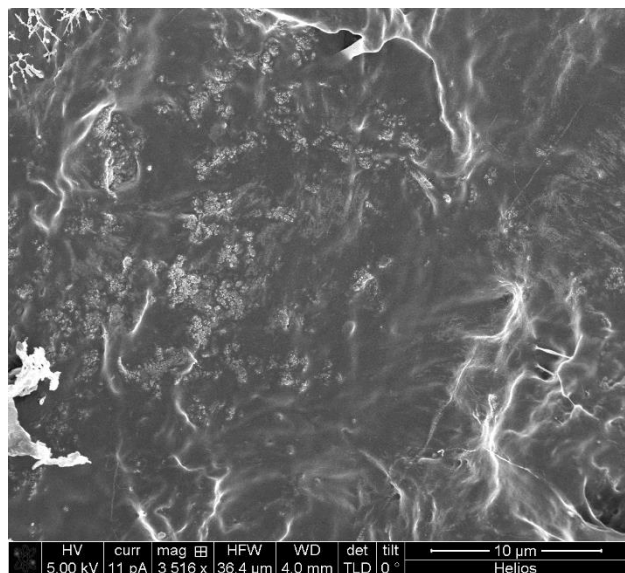
**Figure S7C**



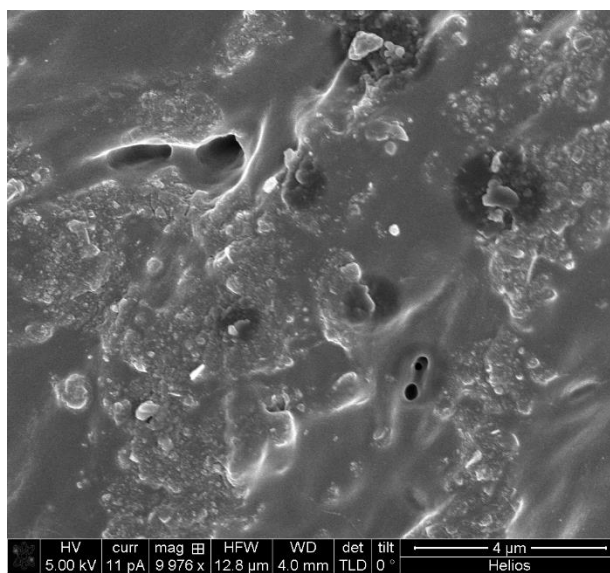
**Figure S7D**

- Figure S7A.** 20% 4-Phenylpyridine film **7a** (bottom) – no extraction
- Figure S7B.** 20% Dibenzothiophene film **5a** (top) – no extraction
- Figure S7C.** 20% Bibenzyl film **2a** (top) – no extraction
- Figure S7D.** 20% Diphenylacetylene film **3a** (bottom) – no extraction

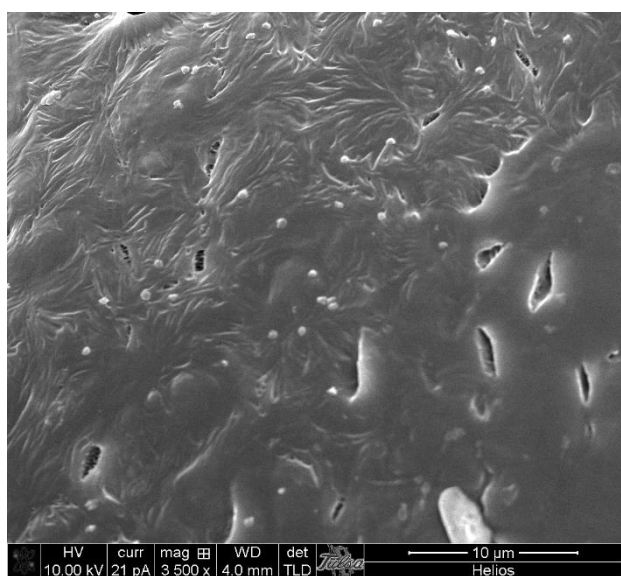




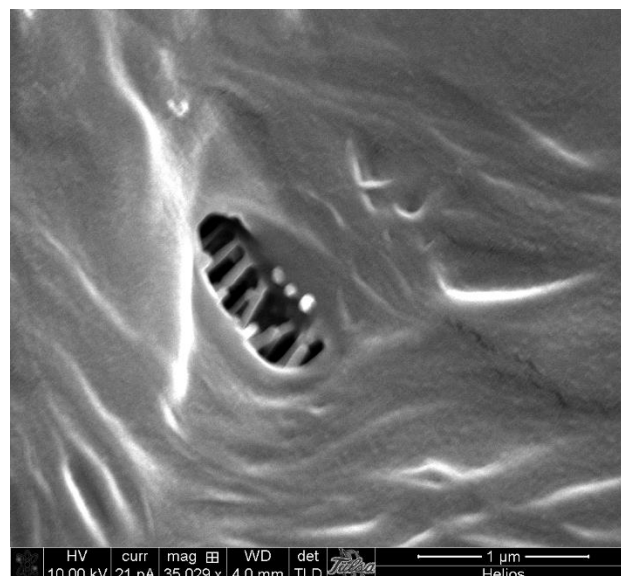
**Figure S8A**



**Figure S8B**



**Figure S8C**



**Figure S8D**

- Figure S8A.** 20% Dibenzothiophene film **5a** (bottom – 3500x) – no extraction  
**Figure S8B.** 20% Dibenzothiophene film **5a** (bottom – 10000x) – no extraction  
**Figure S8C.** 20% Dibenzothiophene film **5b** (top – 3500x) – after extraction  
**Figure S8D.** 20% Dibenzothiophene film **5b** (top – 35000x) – after extraction



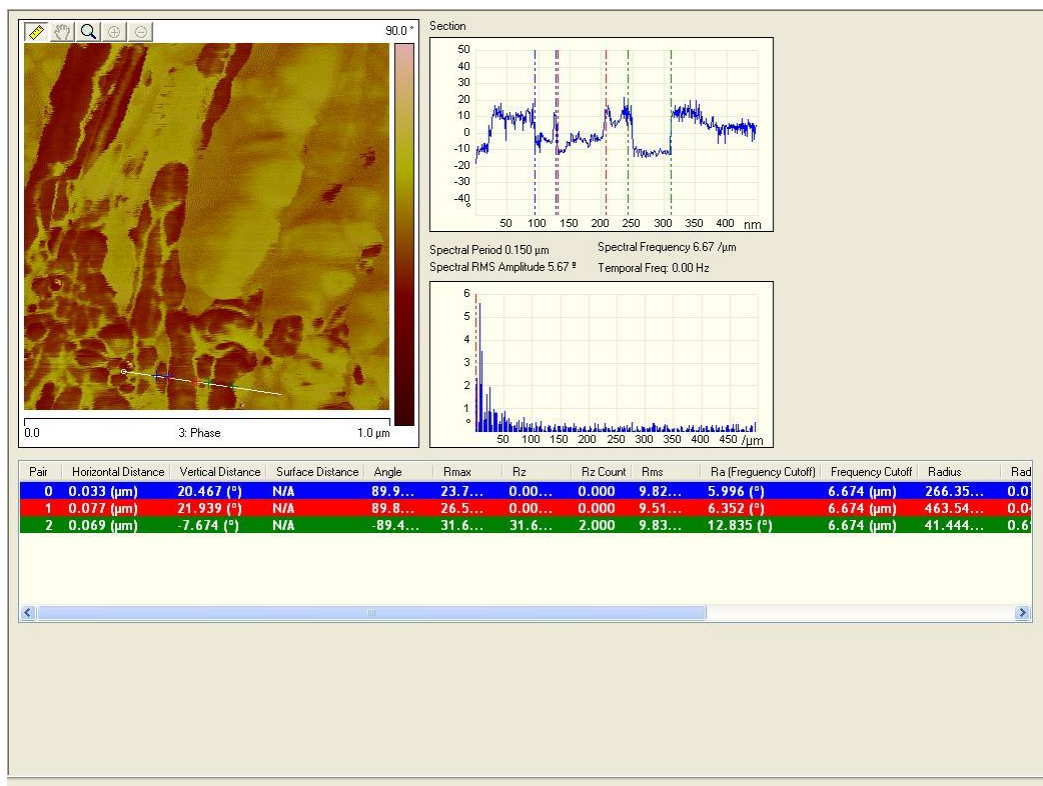
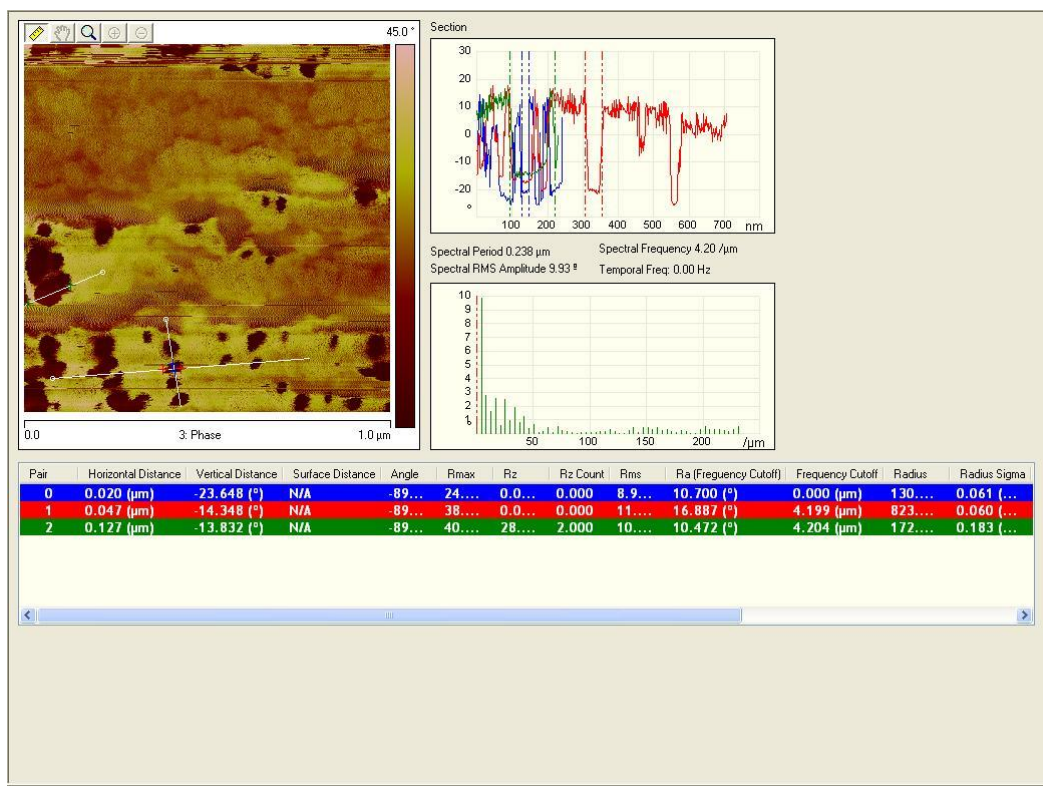
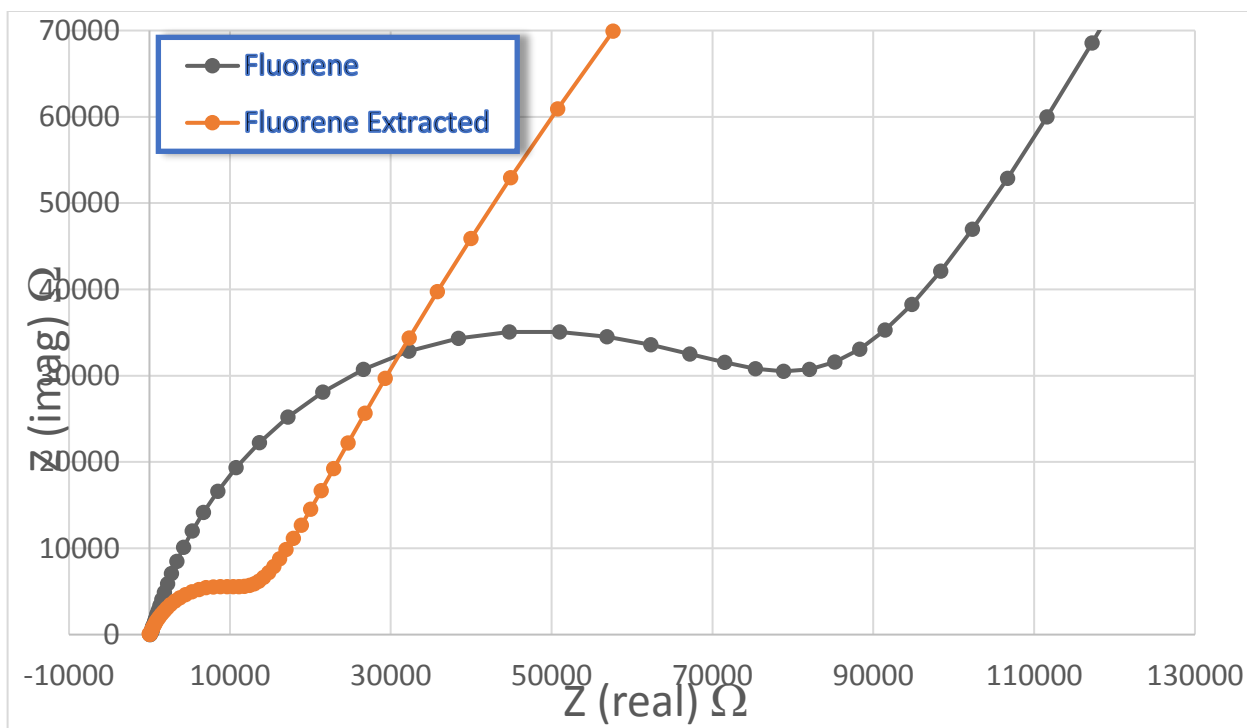
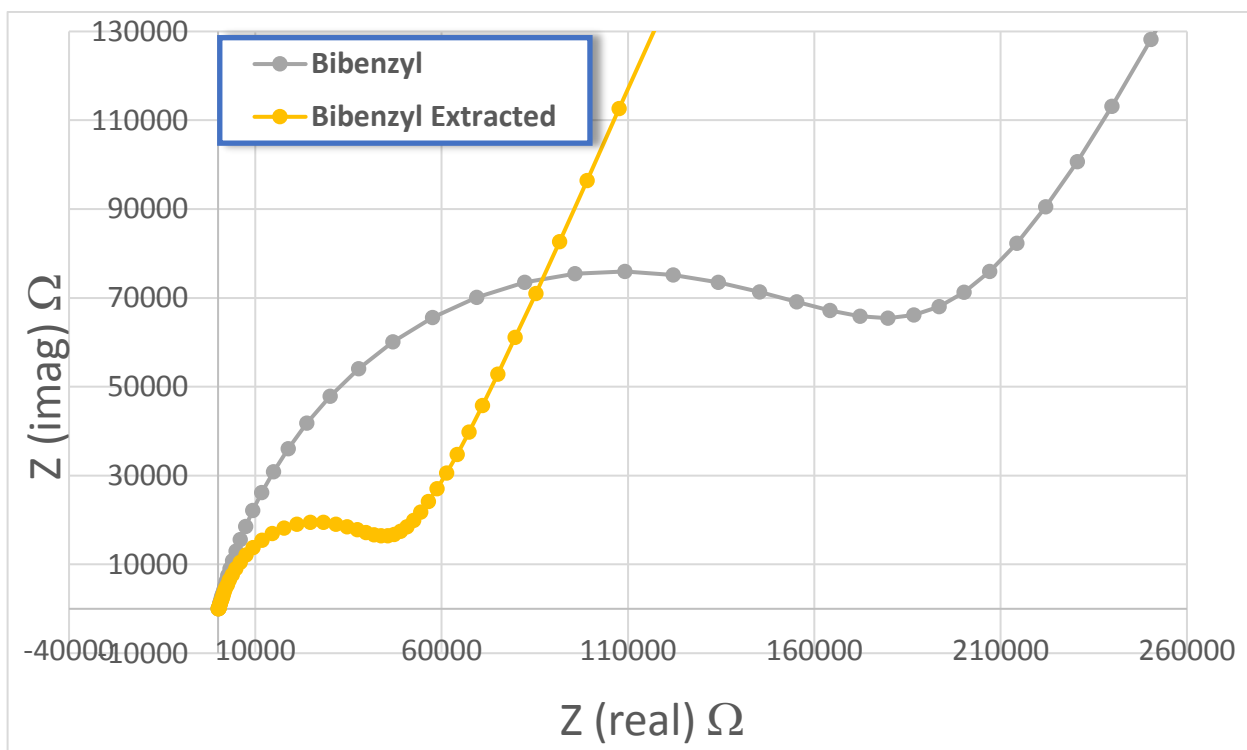


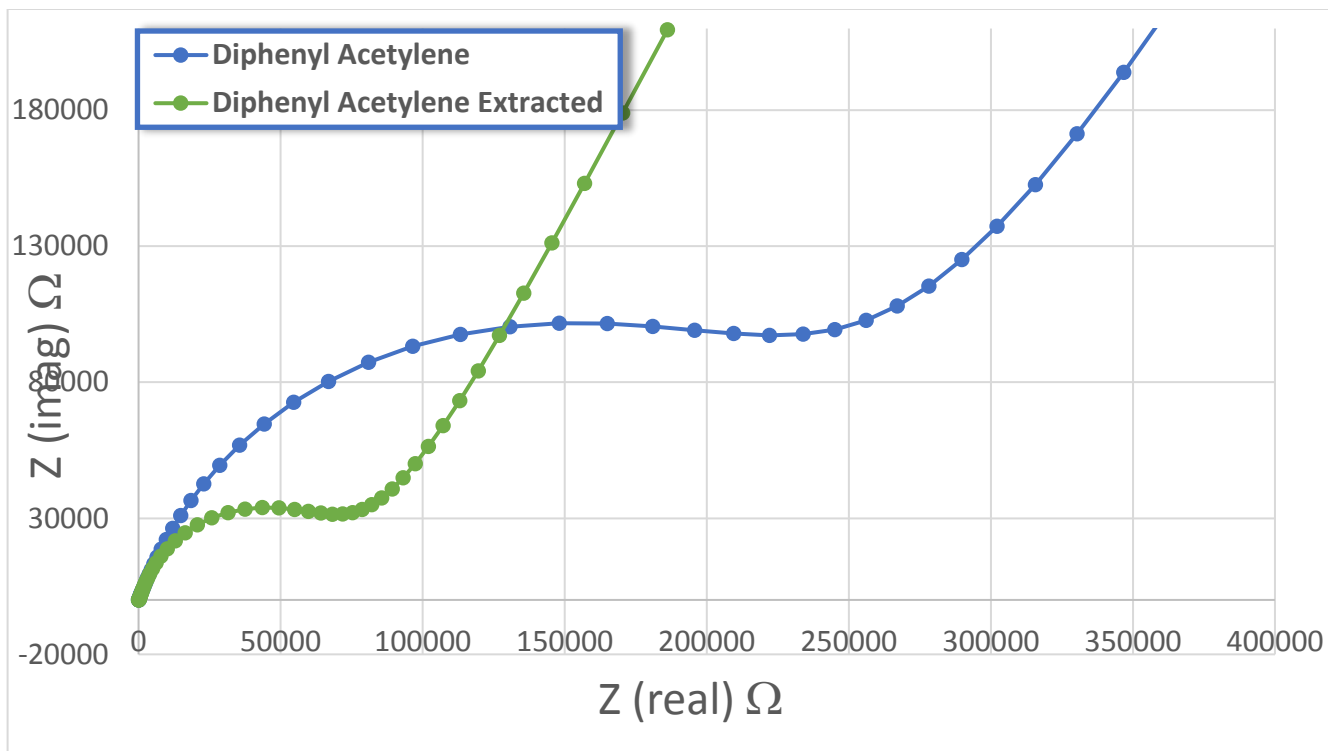
Figure S9A (top) and S9B (bottom) - Bibenzyl film **2b** (top surface) after extraction



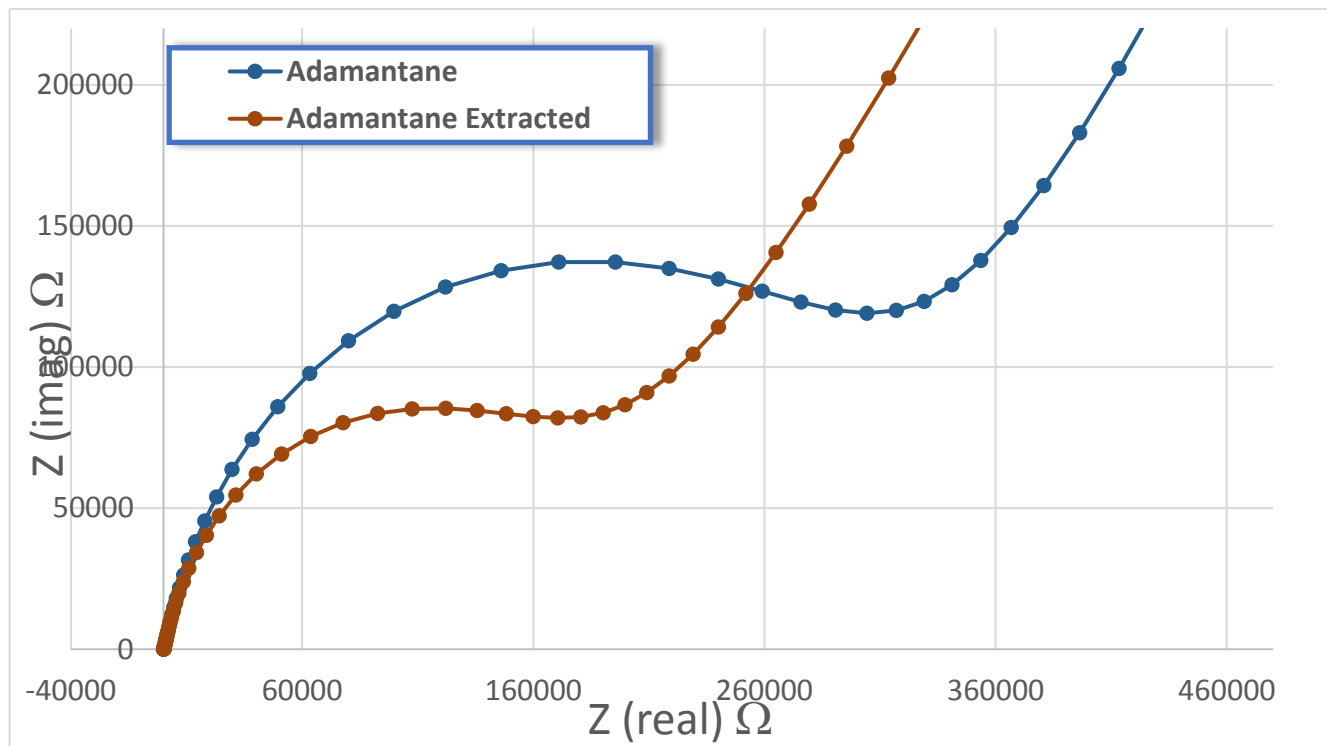
**Figure S10** – Nyquist plots of non-extracted and extracted PEO-LiOTf films (**1a** and **1b**) containing fluorene.



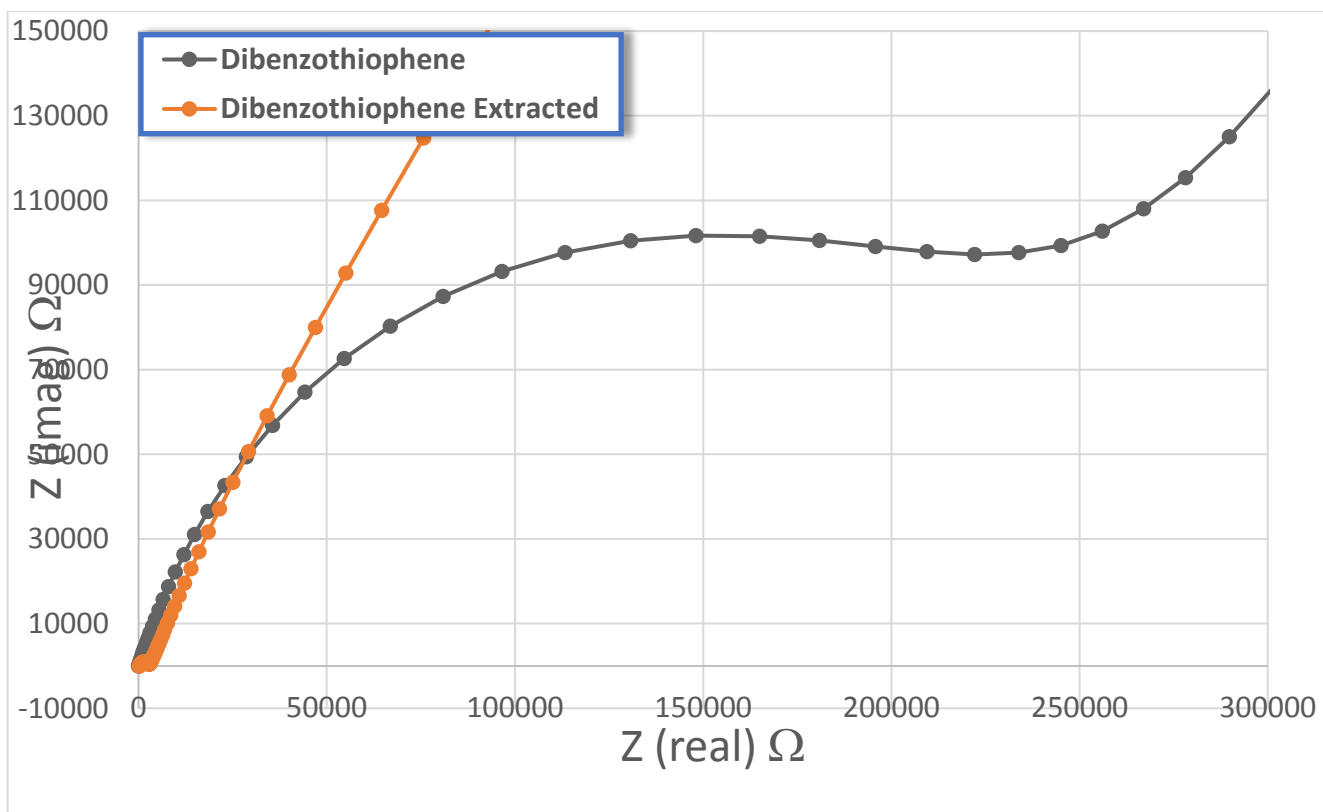
**Figure S11** – Nyquist plots of non-extracted and extracted PEO-LiOTf films (**2a** and **2b**) containing bibenzyl.



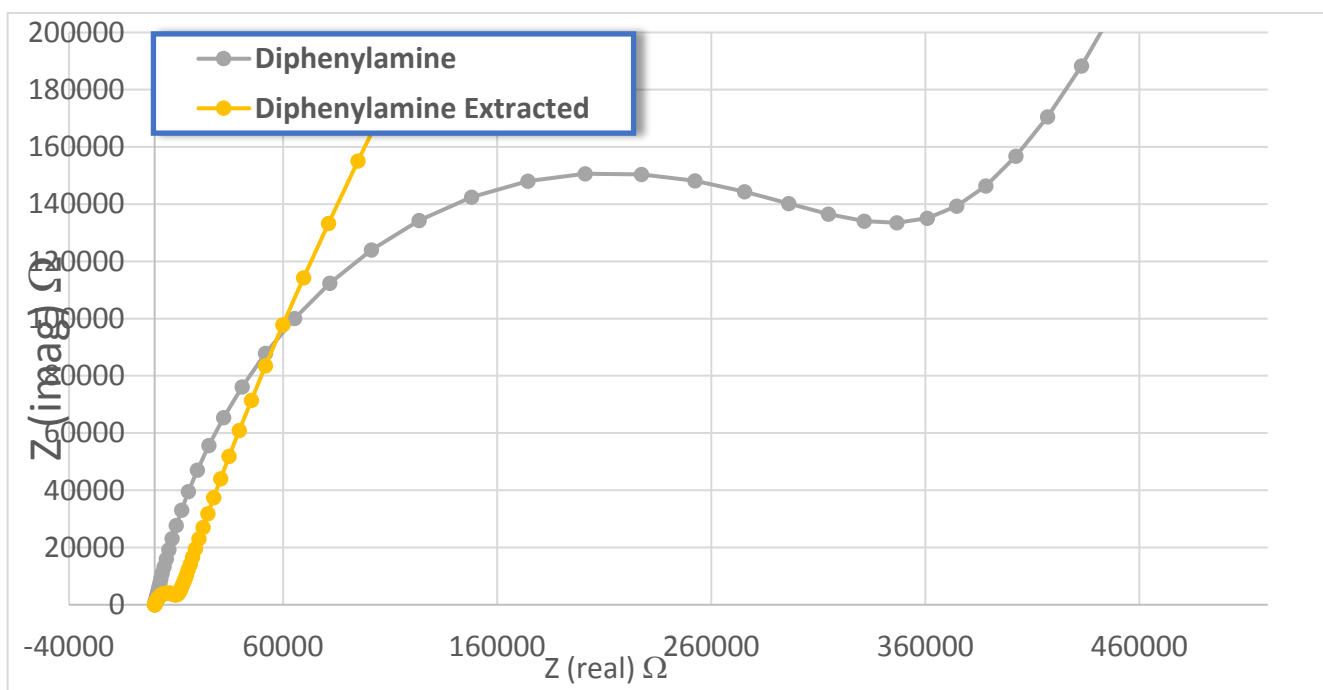
**Figure S12** – Nyquist plots of non-extracted and extracted PEO-LiOTf films (**3a** and **3b**) containing diphenylacetylene.



**Figure S13** – Nyquist plots of non-extracted and extracted PEO-LiOTf films (**4a** and **4b**) containing adamantane.

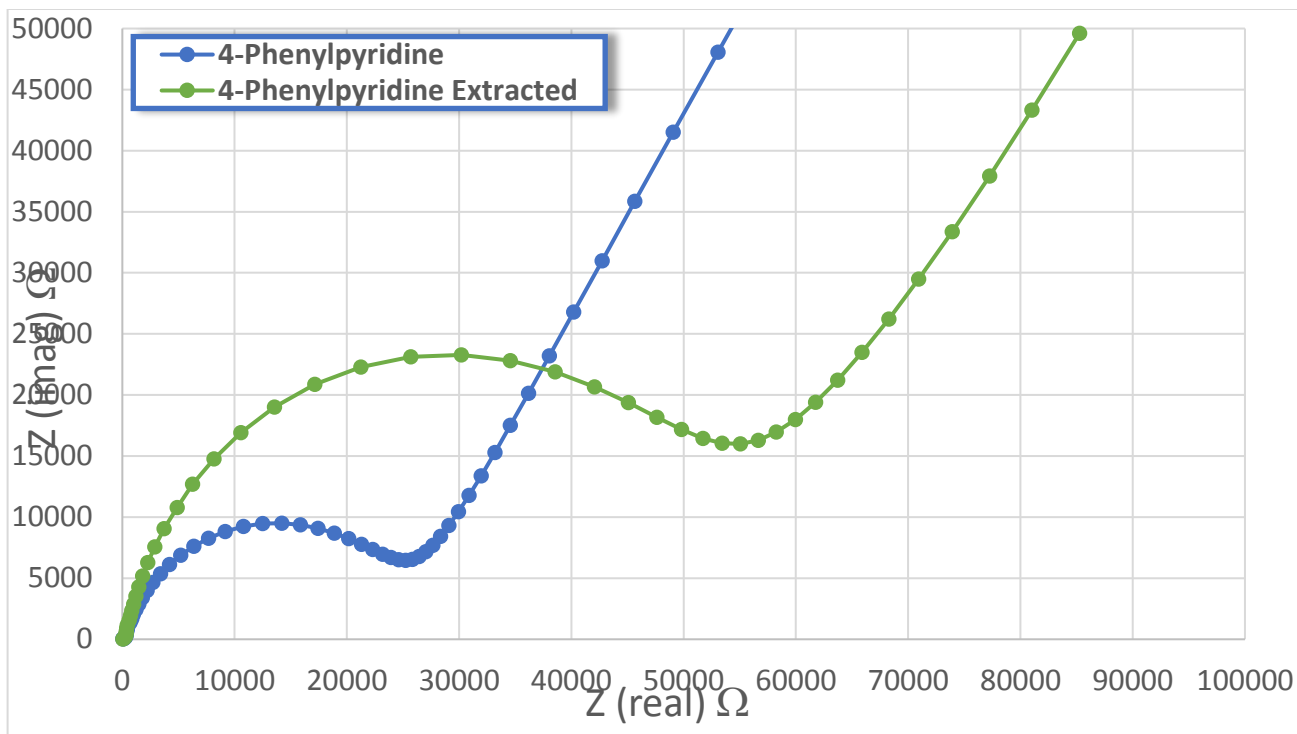


**Figure S14** – Nyquist plots of non-extracted and extracted PEO-LiOTf films (**5a** and **5b**) containing dibenzo thiophene.

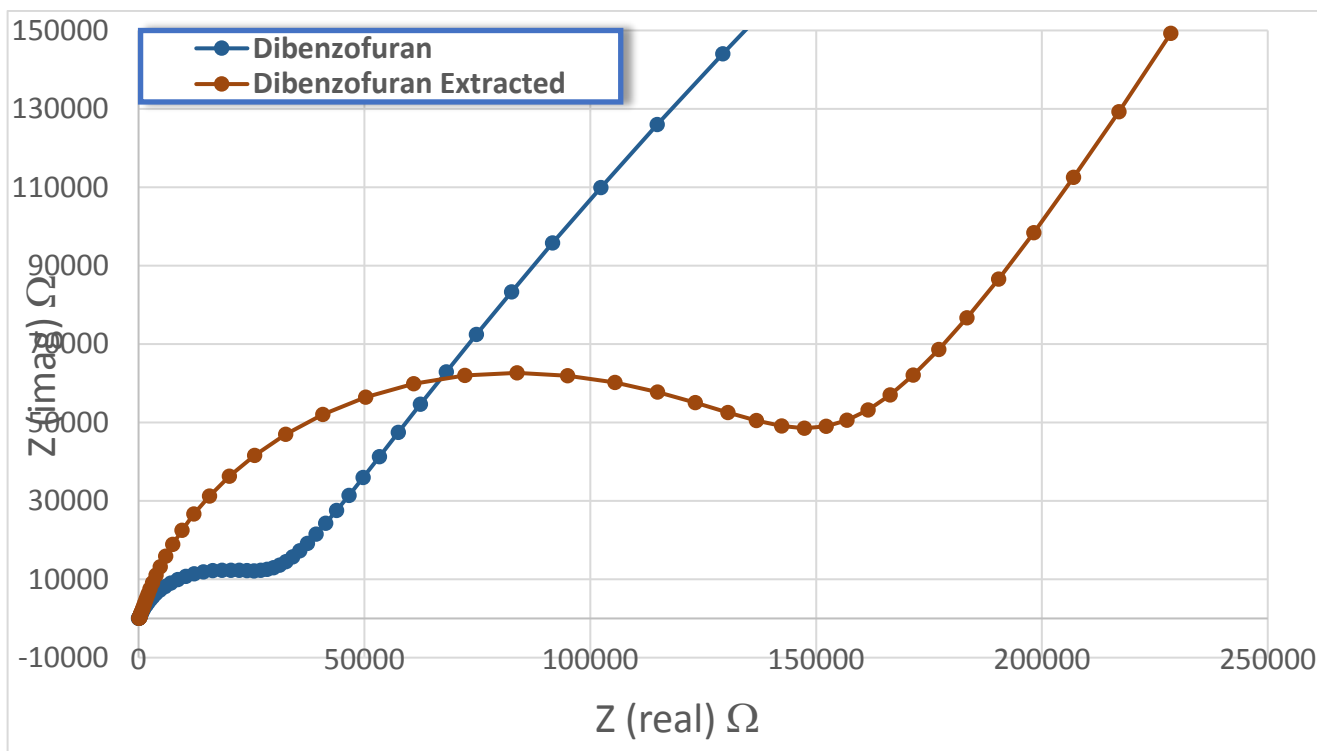


**Figure S15** – Nyquist plots of non-extracted and extracted PEO-LiOTf films (**6a** and **6b**) containing diphenylamine.

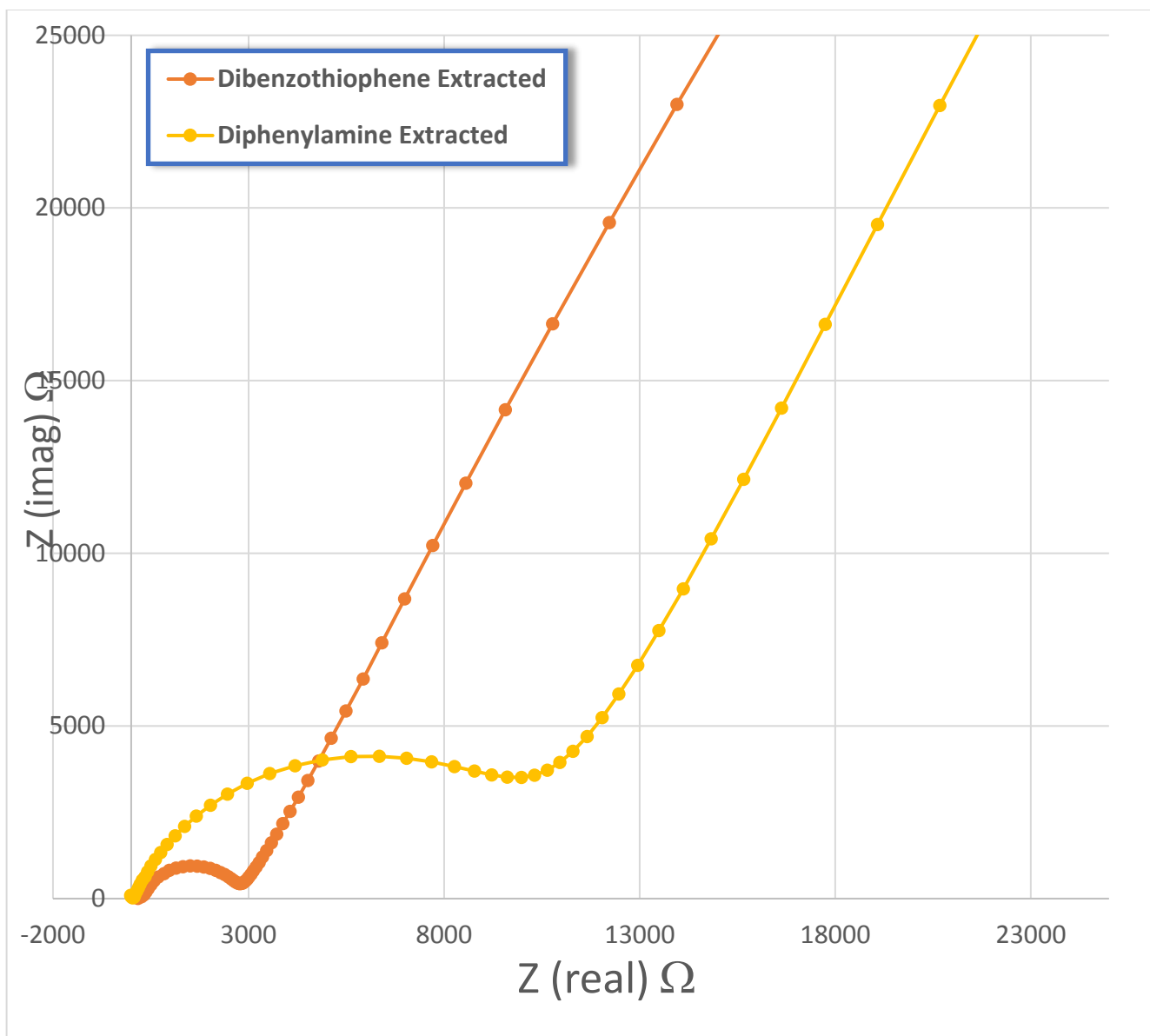




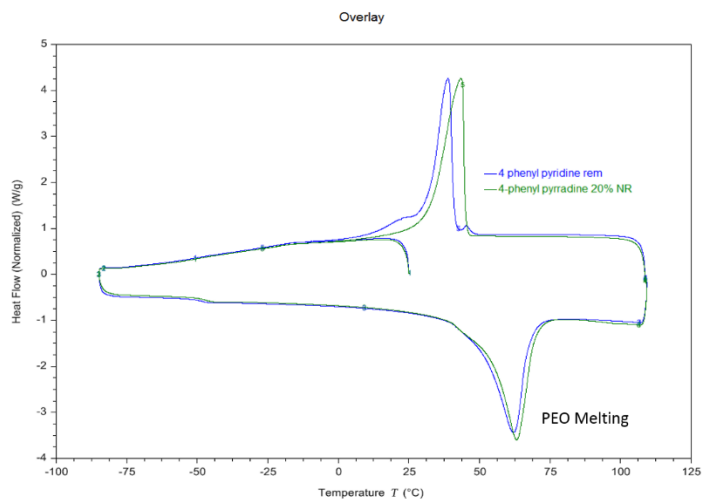
**Figure S16** – Nyquist plots of non-extracted and extracted PEO-LiOTf films (**7a** and **7b**) containing 4-phenylpyridine.



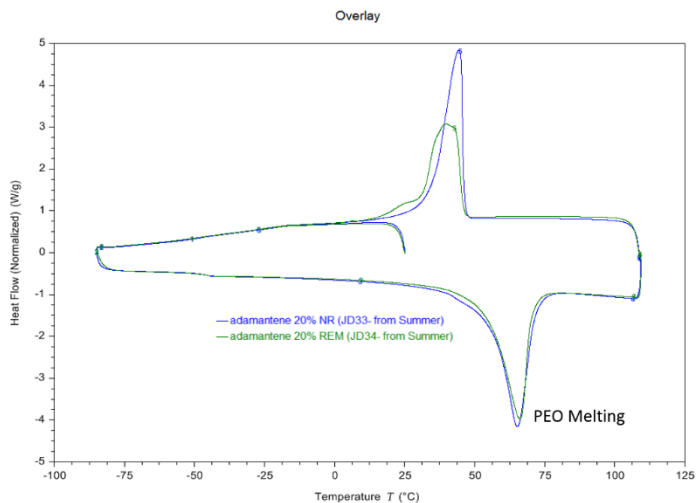
**Figure S17** – Nyquist plots of non-extracted and extracted PEO-LiOTf films (**8a** and **8b**) containing dibenzofuran.



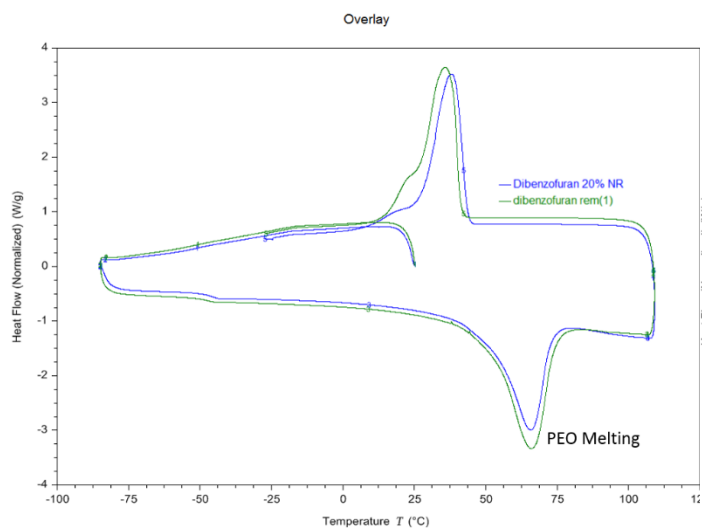
**Figure S18** – Magnified Nyquist plots of extracted PEO-LiOTf films (**5b** and **6b**).



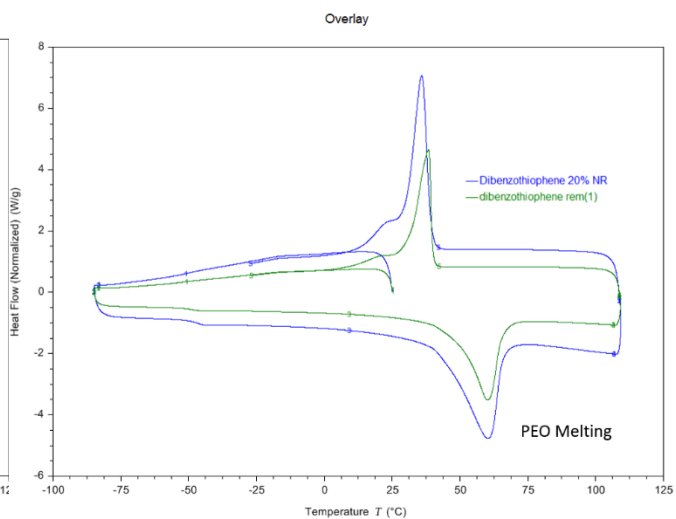
**Figure S19A** – DSC plot of films **7a** and **7b**



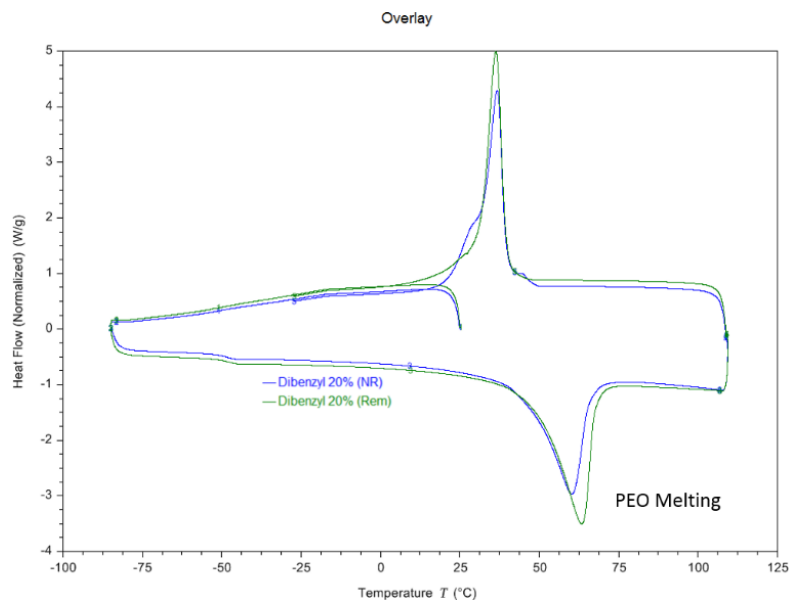
**Figure S19B** – DSC plot of films **4a** and **4b**



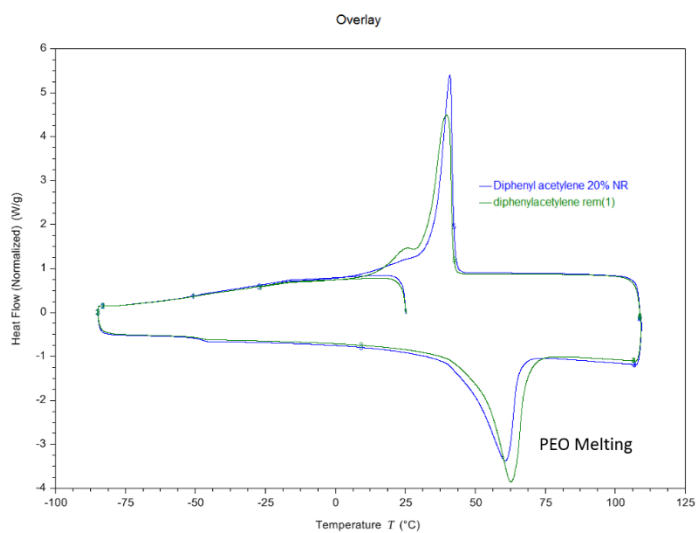
**Figure S19C** – DSC plot of films **8a** and **8b**



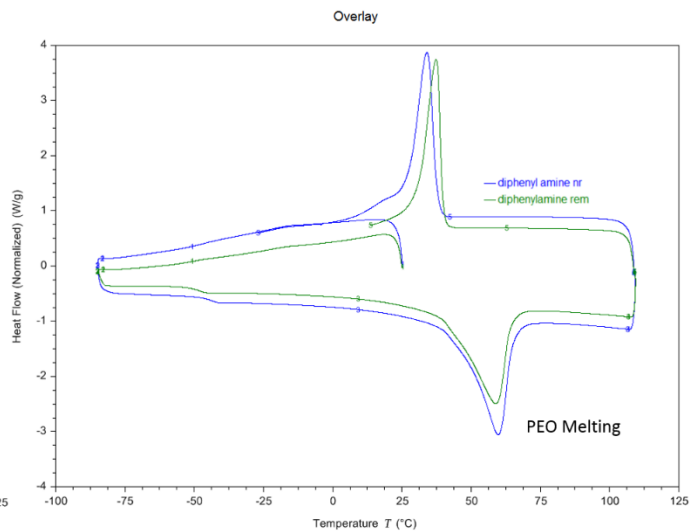
**Figure S19D** – DSC plot of films **5a** and **5b**



**Figure S19E** – DSC plot of films **2a** and **2b**

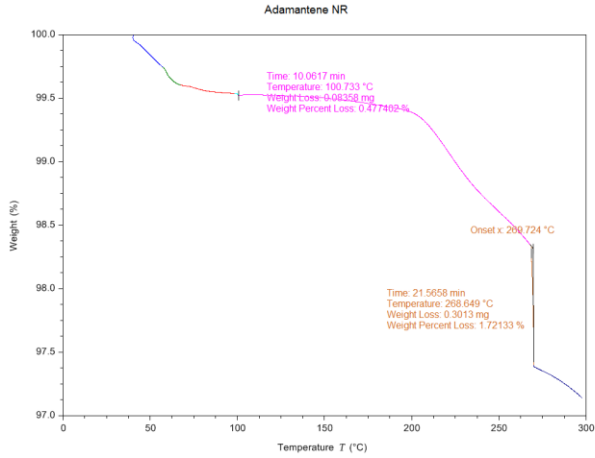


**Figure S19F** – DSC plot of films **3a** and **3b**

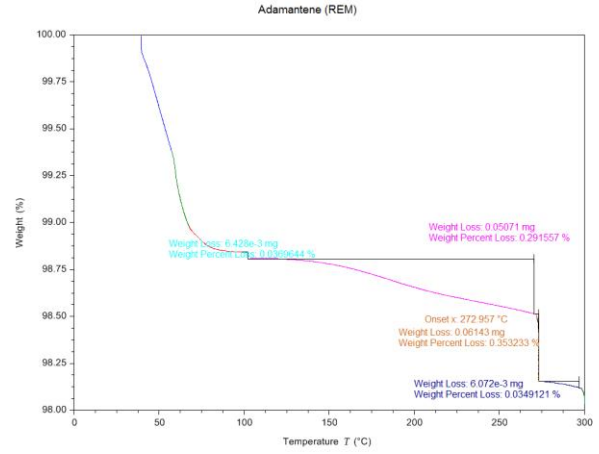


**Figure S19G** – DSC plot of films **6a** and **6b**

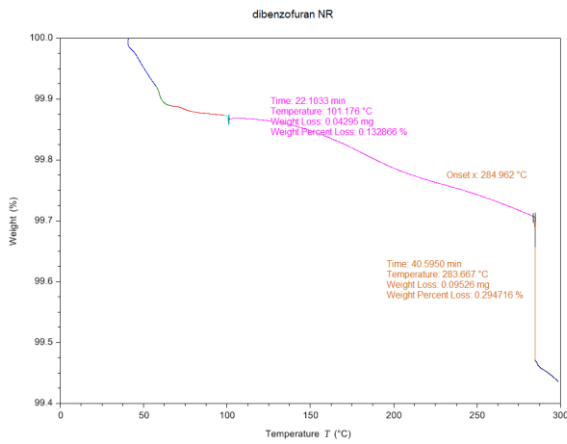




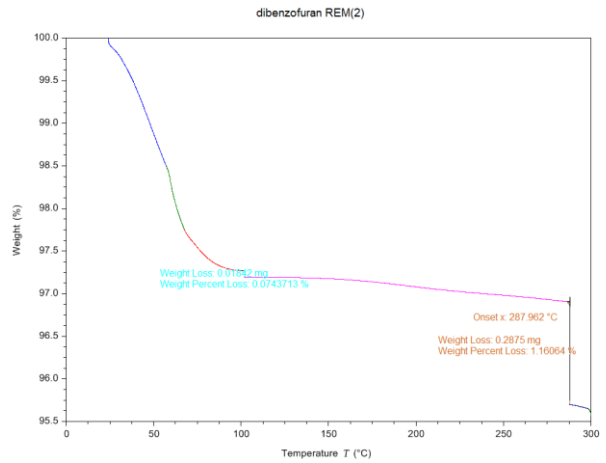
**Figure S20A – TGA plot of film 4a**



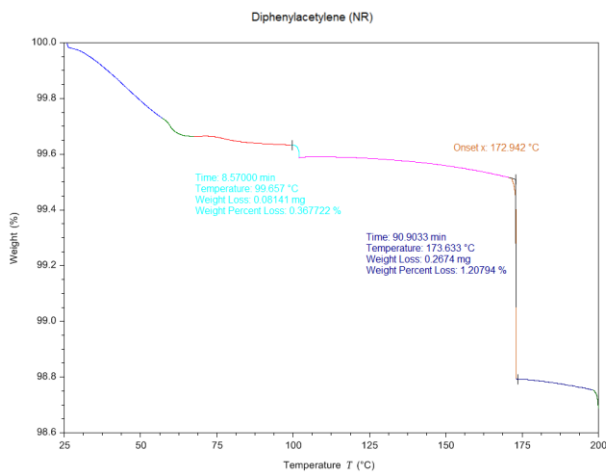
**Figure S20B – TGA plot of film 4b**



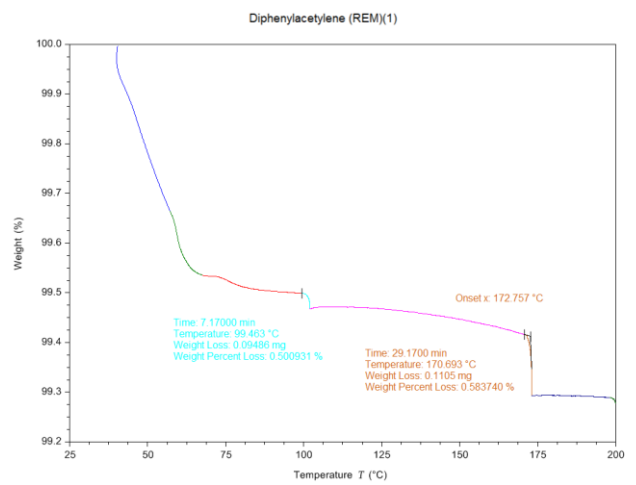
**Figure S20C – TGA plot of film 8a**



**Figure S20D – TGA plot of film 8b**



**Figure S20E – TGA plot of film 3a**



**Figure S20F – TGA plot of film 3b**

In Figures S21A-H, nanofiller compounds were dissolved in acetonitrile and the solvent was then evaporated under air flow. The crystallizing behavior can be observed in the photograph.

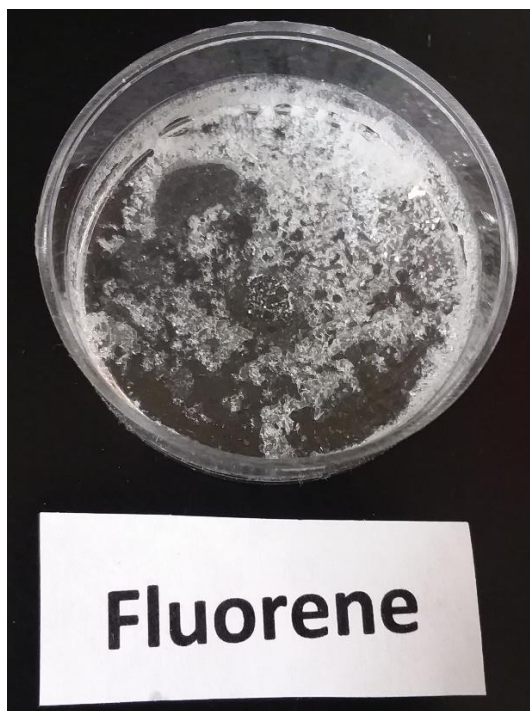


Figure S21A – Crystallization of fluorene from evaporated acetonitrile.  
Notes – Moderate solubility; flaky crystals form.

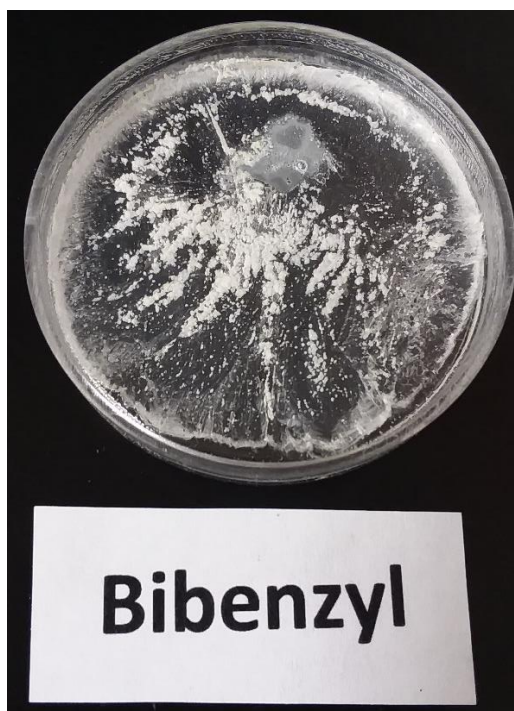


Figure S21B - Crystallization of bibenzyl from evaporated acetonitrile.  
Notes – Low solubility; powdery solid forms.

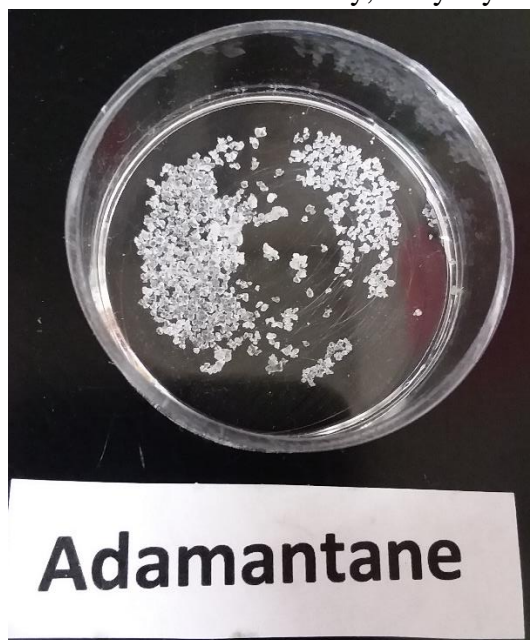


Figure S21C – Crystallization of adamantane from evaporated acetonitrile.  
Notes – Very low solubility; blocky crystals form.

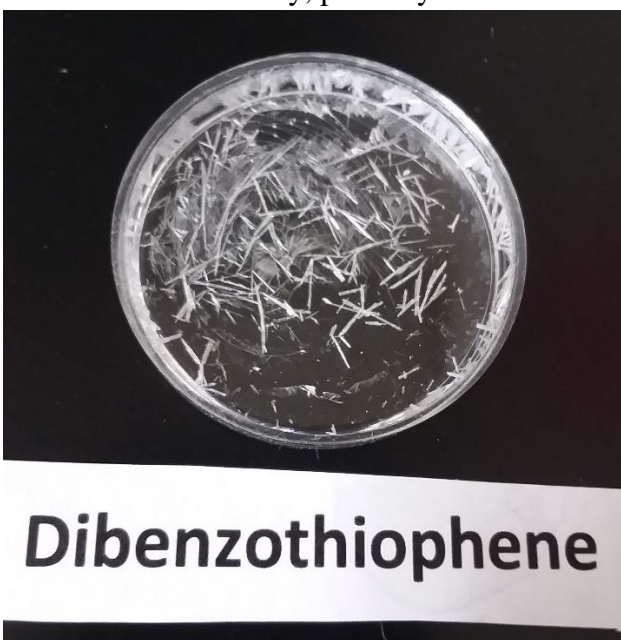
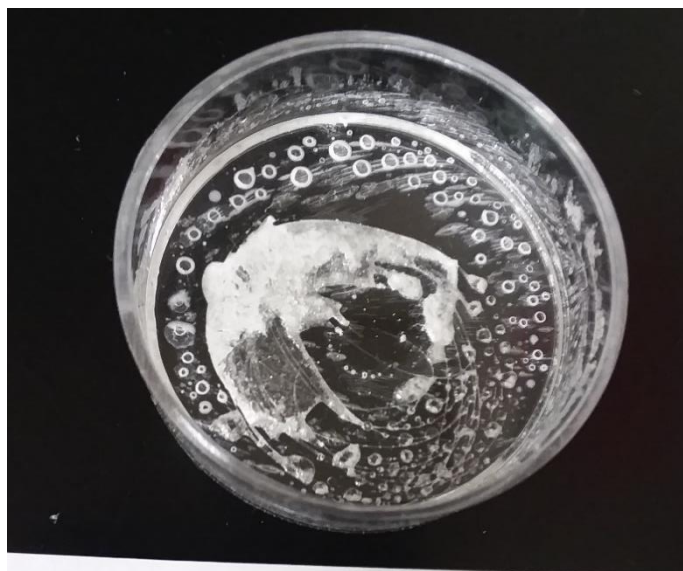


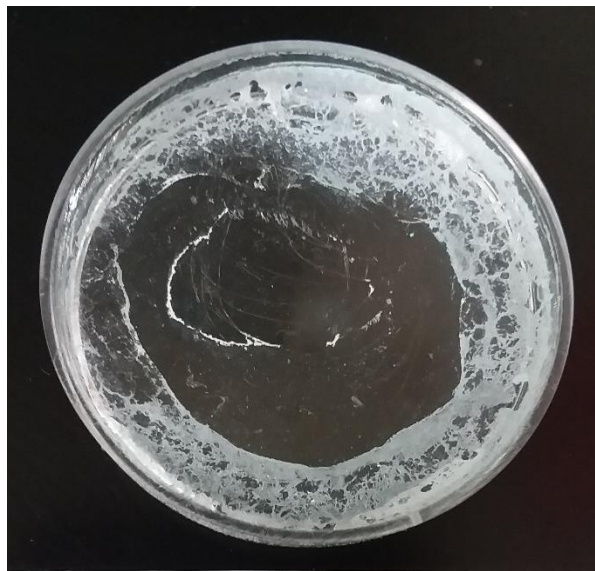
Figure S21D - Crystallization of dibenzothiophene from evaporated acetonitrile.  
Notes – Very soluble; needle-like crystals form.



**4-Phenylpyridine**

Figure S21E – Crystallization of 4-phenylpyridine from evaporated acetonitrile.

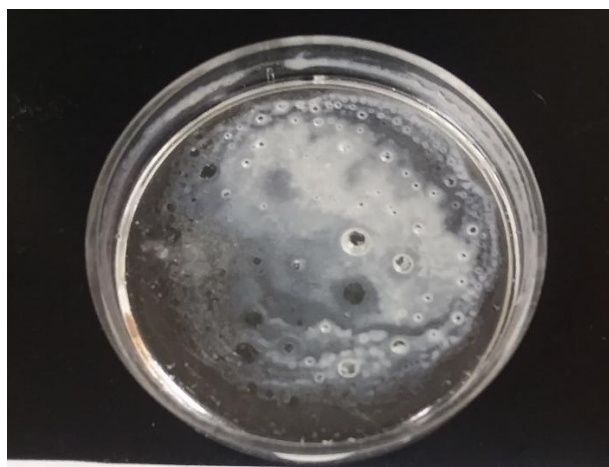
Notes – Very soluble; powdery crystals form.



**Dibenzofuran**

Figure S21F - Crystallization of dibenzofuran from evaporated acetonitrile.

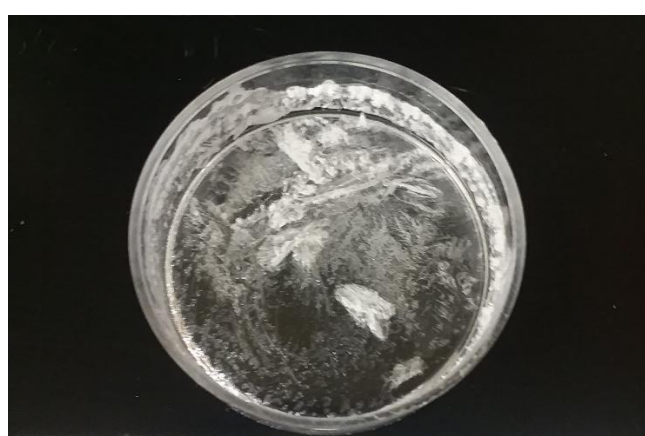
Notes – Very soluble; filmy, powdery solid forms.



**Diphenylamine**

Figure S21G – Crystallization of diphenylamine from evaporated acetonitrile.

Notes – Very soluble; filmy solid forms.



**Diphenylacetylene**

Figure S21H - Crystallization of diphenylacetylene from evaporated acetonitrile.

Notes – Moderate to very soluble; powdery crystals form.

All photos taken by A. Lamar.