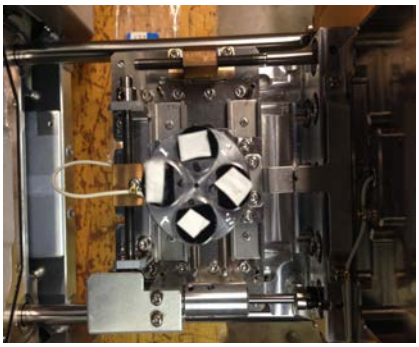
# Hitachi TM3000 - SEM Exploration Activity

Use the SEM Operation Instructions located in Dropbox or in the folder in front of the SEM.

**SafeSense**
SEM Exploration – Specimen Analysis Sheet

Christopher Barr
Cory Bogas
Victoria Christensen



| Sample ID | Line 1: Specimen Description<br>Line 2: Purpose for Analysis | Page number in Journal |
|---|---|---|
| A | PMMA | |
| | To test shock absorbing characteristics | |
| B | 300k MW PEO | |
| | To test shock absorbing characteristics | |
| C | 900k MW PEO | |
| | To test shock absorbing characteristics | |
| D | Waterlock | |
| | To test shock absorbing characteristics | |

**NOTES:**
- **Flow rate when we spun 300K PEO was too high**
- **Waterlock absorbs water**
- **PMMA is used to make plexi-glass**
- **PEO is a biocompatible material**

**APPROVAL:**

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**OBSERVATIONS:**

**Specimen #1:**
- **Less dense than other fibers**
- **fuzzy**

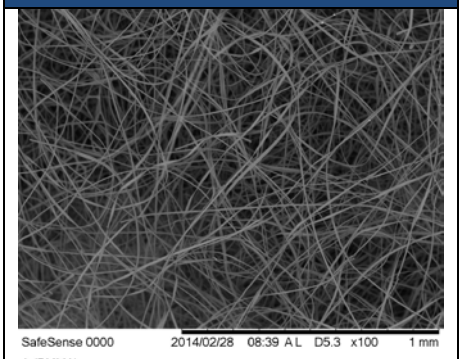
**Specimen #2:**
- **Thin mat of fibers**
- **Water droplets visible on fibers (high flow rate)**

**Specimen #3:**
- **When placing the fibers on the stub, the tweezers pinched the nanofibers, creating a rip in them**

**Specimen #4:**
- **Opaque fibers with water absorbency properties**

## Specimen 1 A (PMMA), Point 1

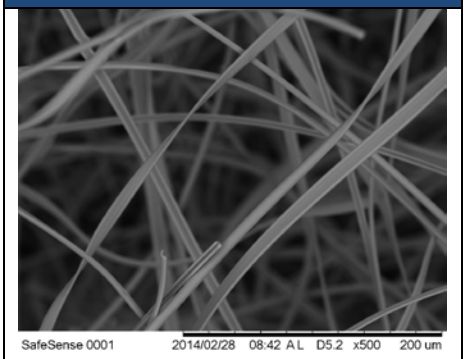
### 100X




**OBSERVATIONS:**

- **Random orientation**
- **Large Fibers**
- **Thin fibers (thickness)**

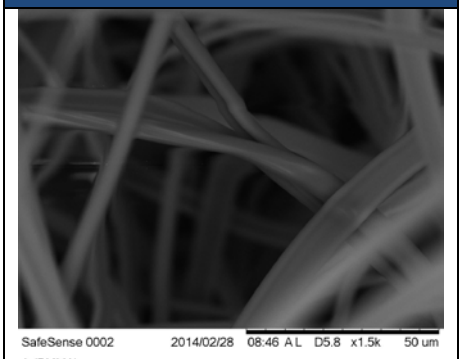
### 500X




**OBSERVATIONS:**

- **Flat Fibers**
- **Have the potential to roll up**
- **Like blades of grass or dental floss**

### 1500X

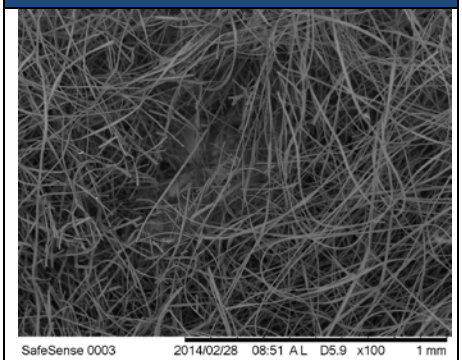



**OBSERVATIONS:**

- **So thin that they are transparent**
- **Melted by the electron beam**
- **Large gaps between fibers**

## Specimen 1 A (PMMA), Point 2

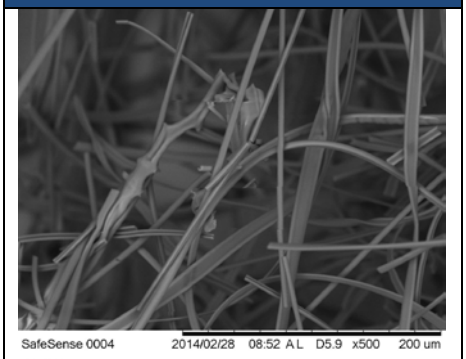
### 100X




**OBSERVATIONS:**

- **Broken fibers**
- **Possibly where the tweezers pinched them**

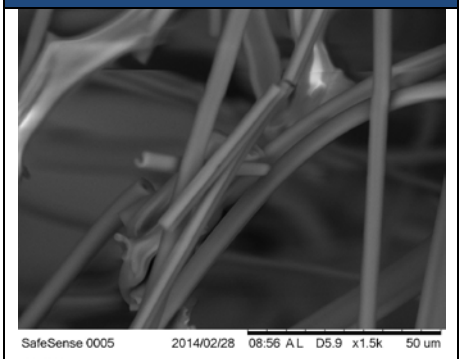
### 500X




**OBSERVATIONS:**

- **Fibers starting to melt**
- **Twisting and rolling up**
- **Look thicker than normal fibers (in diameter)**
- **Possibly strong**

### 1500X



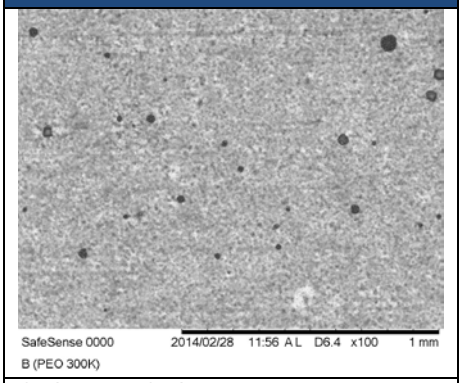

**OBSERVATIONS:**

- **Looks like nano-scale tubes or straws**
- **Since air is in the tubes, it could have good shock absorbing qualties**

**CONCLUSION:**
**It is easy to visualize that this polymer is used in plexi-glass because it looks strong. Definitely want to attempt to spin this in bulk and drop test on a thick mat to see how well it absorbs shock. The pockets of air lead us to believe that it could be useful for our research.**

## Specimen 2 B (300k PEO), Point 1

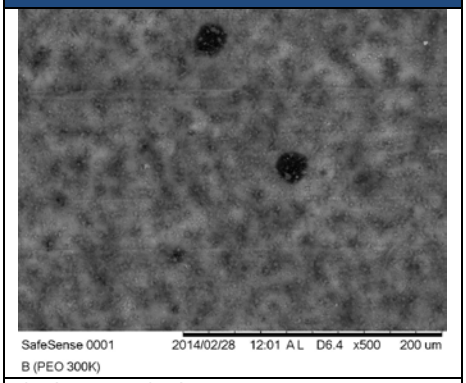
### 100X




**OBSERVATIONS:**

- **Water droplets are visible**
- **More dots than fibers**
- **Individual fibers not as visible**

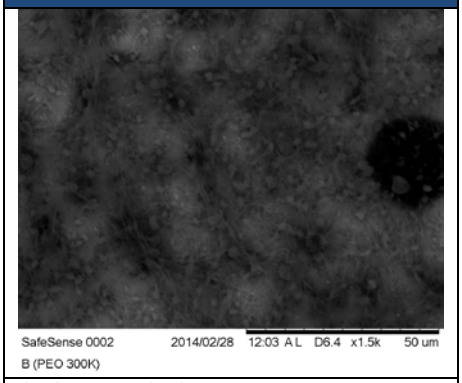
### 500X




**OBSERVATIONS:**

- **Cloudy**
- **Dots**
- **Black lines could be fibers but is unclear**

### 1500X

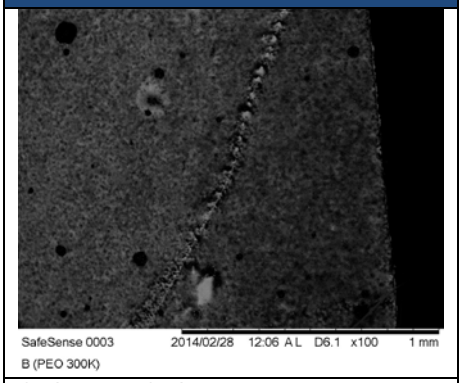



**OBSERVATIONS:**

- **Thin fibers connected to drops of PEO polymer**
- **No fibers because of low MW**

## Specimen 2 B (300k PEO), Point 2

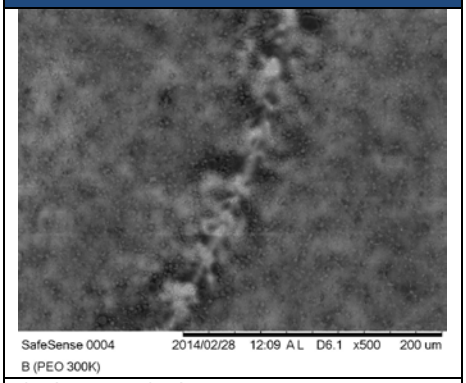
### 100X




**OBSERVATIONS:**

- **Could be a surface scratch on the fibers**
- **Or a big fiber?**

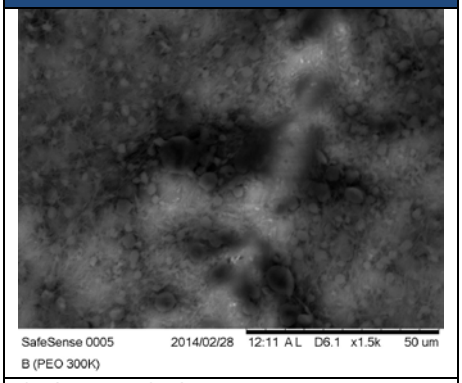
### 500X




**OBSERVATIONS:**

- **Still see droplets of PEO**
- **Looks like stitches or an x-ray of a spine**

### 1500X



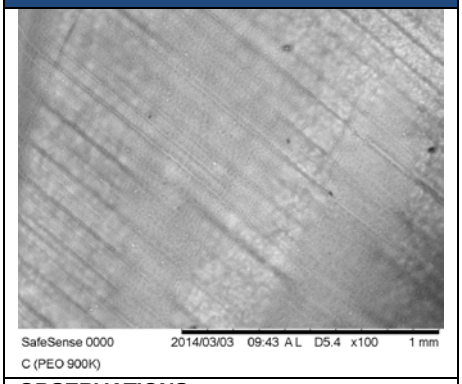

**OBSERVATIONS:**

- **Droplets of water?**
- **Too blurry to make out any fibers**

**CONCLUSION:**
**This polymer would not be helpful for our research because of the low density and virtually no pockets of air. Without any fibers, we would not be able to analyze how they deform after impact.**

## Specimen 1 C (900k PEO), Point 1

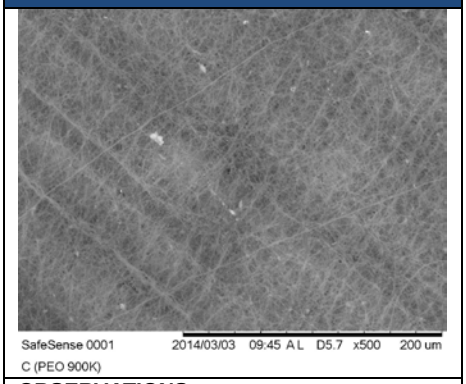
### 100X




**OBSERVATIONS:**

- **Looks like aligned fibers**
- **Cloudy in some spots**

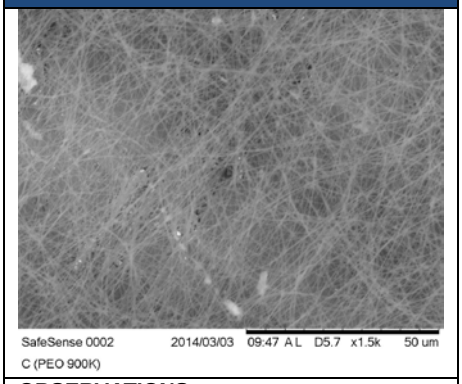
### 500X




**OBSERVATIONS:**

- **Fibers are not aligned**
- **Visible fibers due to a larger MW**

### 1500X

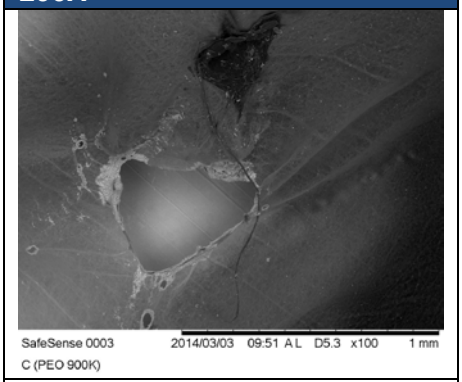



**OBSERVATIONS:**

- **Thin fibers**
- **Not as many air pockets as PMMA**
- **Dried droplets of PEO or water**

## Specimen 1 C (900k PEO), Point 2

### 100X




**OBSERVATIONS:**

- **Spot where tweezers pinched the fibers**
- **Wrinkled surface is visible**
- **Can see aluminum foil is visible underneath**

### 500X


**OBSERVATIONS:**

- **Fibers bunched together after they were broken**
- **Does not look like traditional fibers**
- **Looks like many microorganisms**

### 1500X


**OBSERVATIONS:**

- **Tightly packed fibers**
- **Started to melt under electron beam**
- **Looks webbed**

**CONCLUSION:**
**This polymer is interesting when it bunches up and deforms, so it would be beneficial to test it under our drop test apparatus to see how it reacts to impact. It has less pockets of air, so we expect it to work better than the 300K PEO but not as well as the PMMA.**

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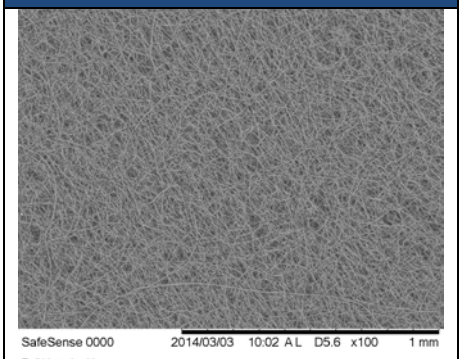
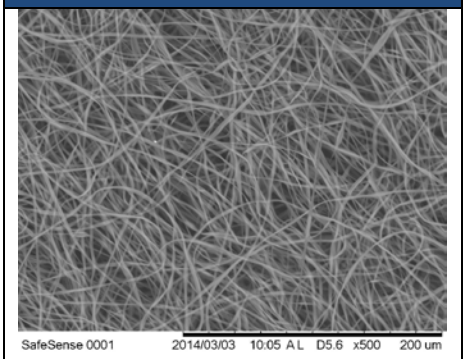
## Specimen 2 D (Waterlock), Point 1

### 100X



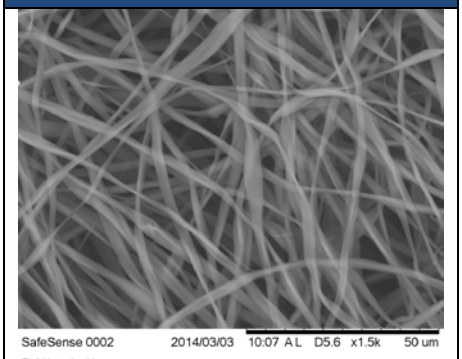

**OBSERVATIONS:**
- **Small but visible fibers**
- **Small pockets of air**
- **Randomly assembled**

### 500X




**OBSERVATIONS:**
- **Dense (more fibers)**
- **Look similar to PMMA**

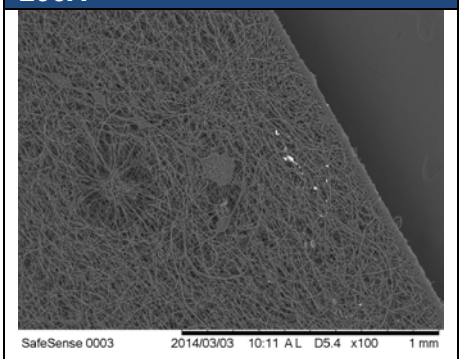
### 1500X




**OBSERVATIONS:**
- **Transparent fibers**
- **Wavy**
- **Seem to be easy to manipulate/bend/squish**

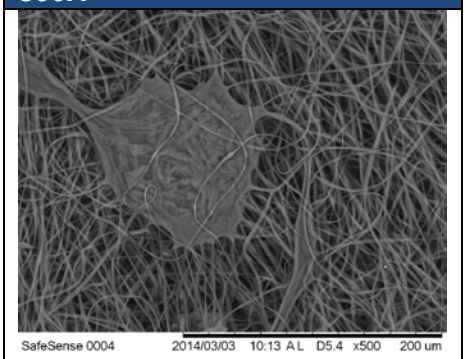
## Specimen 2 D (Waterlock), Point 2

### 100X



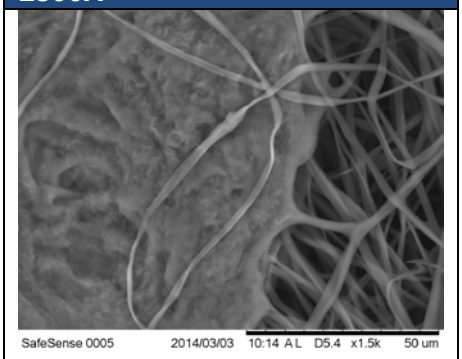

**OBSERVATIONS:**
- **Could be where water fell on the fibers**
- **Bunch together in two spots**

### 500X




**OBSERVATIONS:**
- **Fibers branching off**
- **Water could have been absorbed which led them to be bunched together**

### 1500X




**OBSERVATIONS:**
- **Fibers become thicker in diameter the closer they get to the droplet**
- **Surface of the droplet has folds**
- **Maybe fibers become one when they absorb water?**

**CONCLUSION:**
**Since there are more of these fibers than any other ones that we analyzed, we would expect that these would work the best with impact. However, if we were to put this material in a helmet, sweat would absorb in it and could possibly change the characteristics of the fibers.**