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10-12-2018

## Electron Yield of Carbon-Composite Nanodielectric

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### Recommended Citation

Robertson, Matthew; Christensen, Justin; Wilson, Gregory; and Dennison, JR, "Electron Yield of Carbon-Composite Nanodielectric" (2018). Fall 2018 Four Corner Section Meeting of the American Physical Society. *Presentations*. Paper 179.

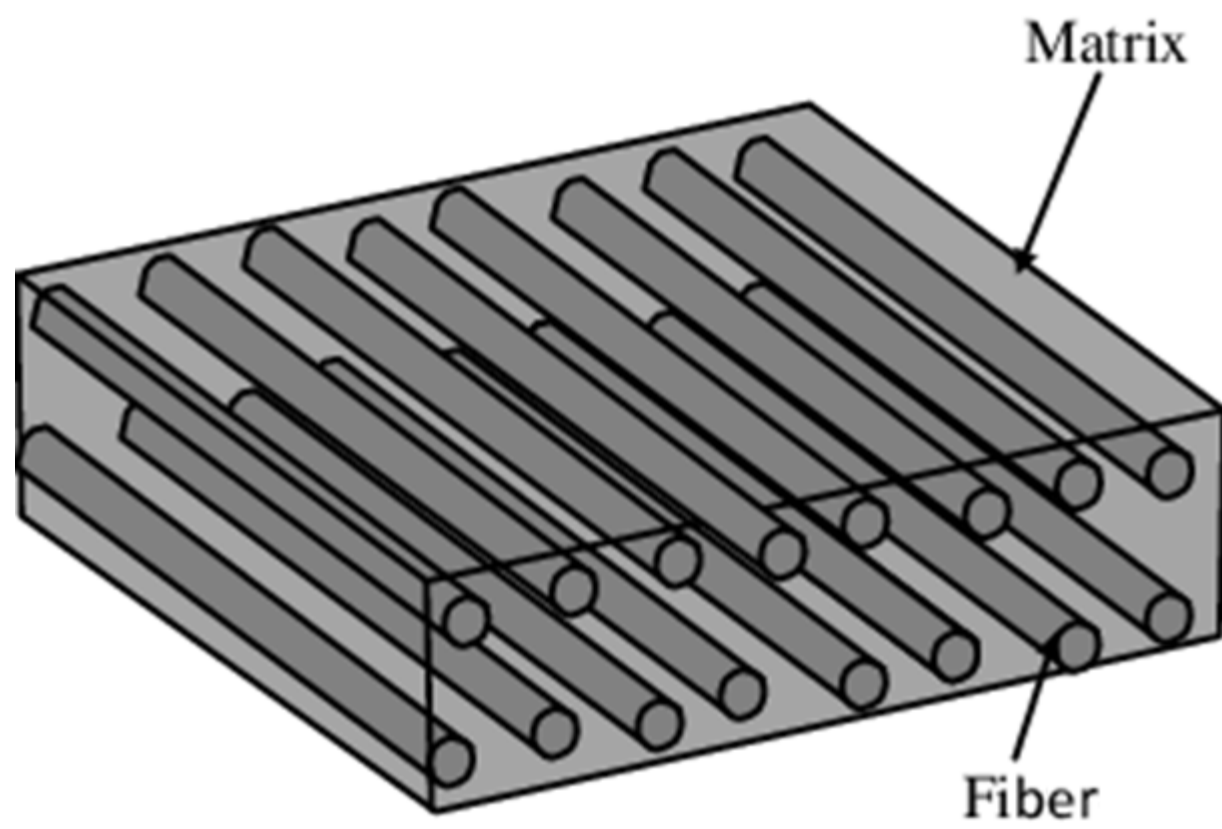
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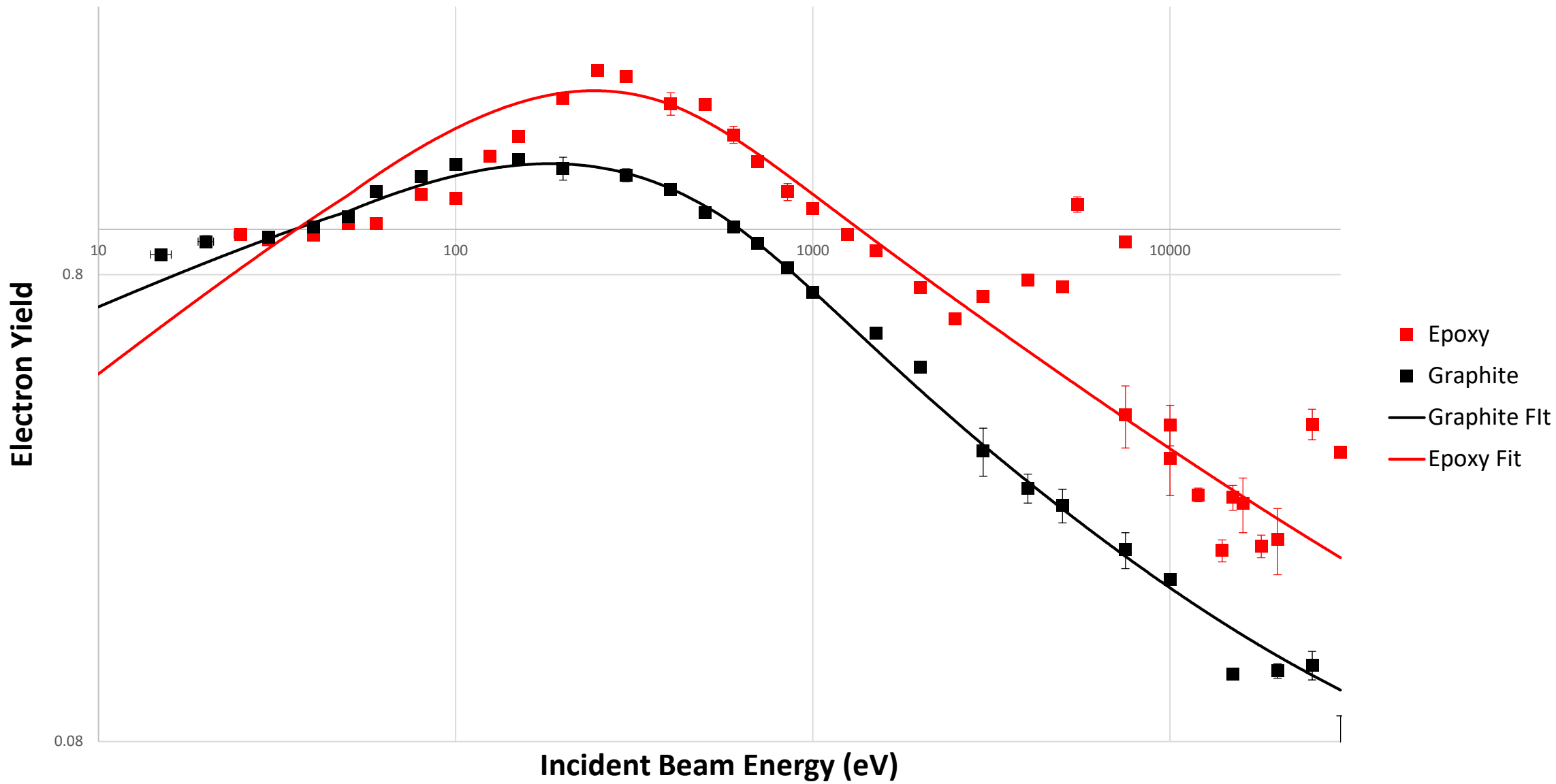


# Electron Yield of a Carbon-composite Nanodielectric

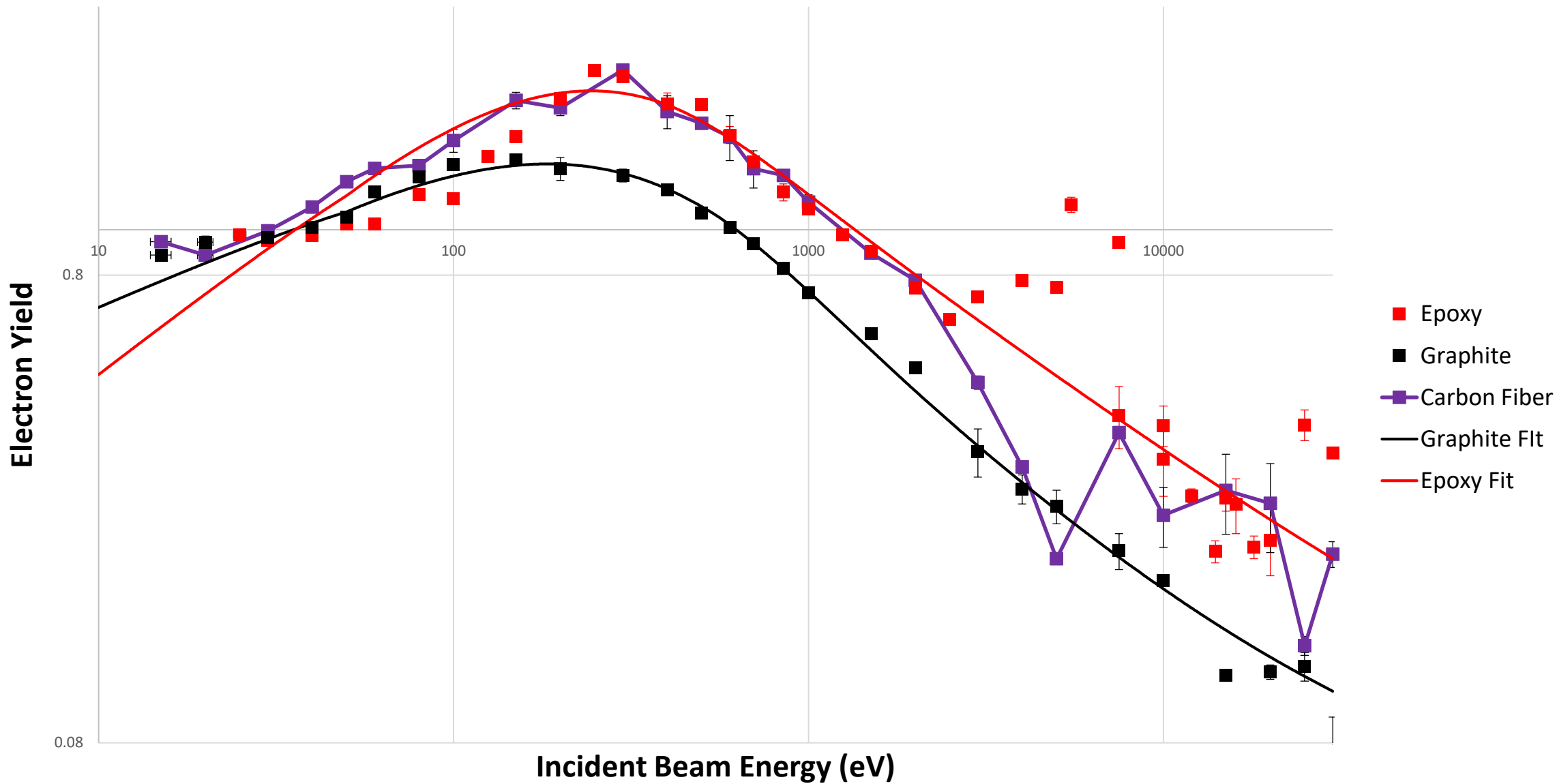




### Comparison of Electron Yields



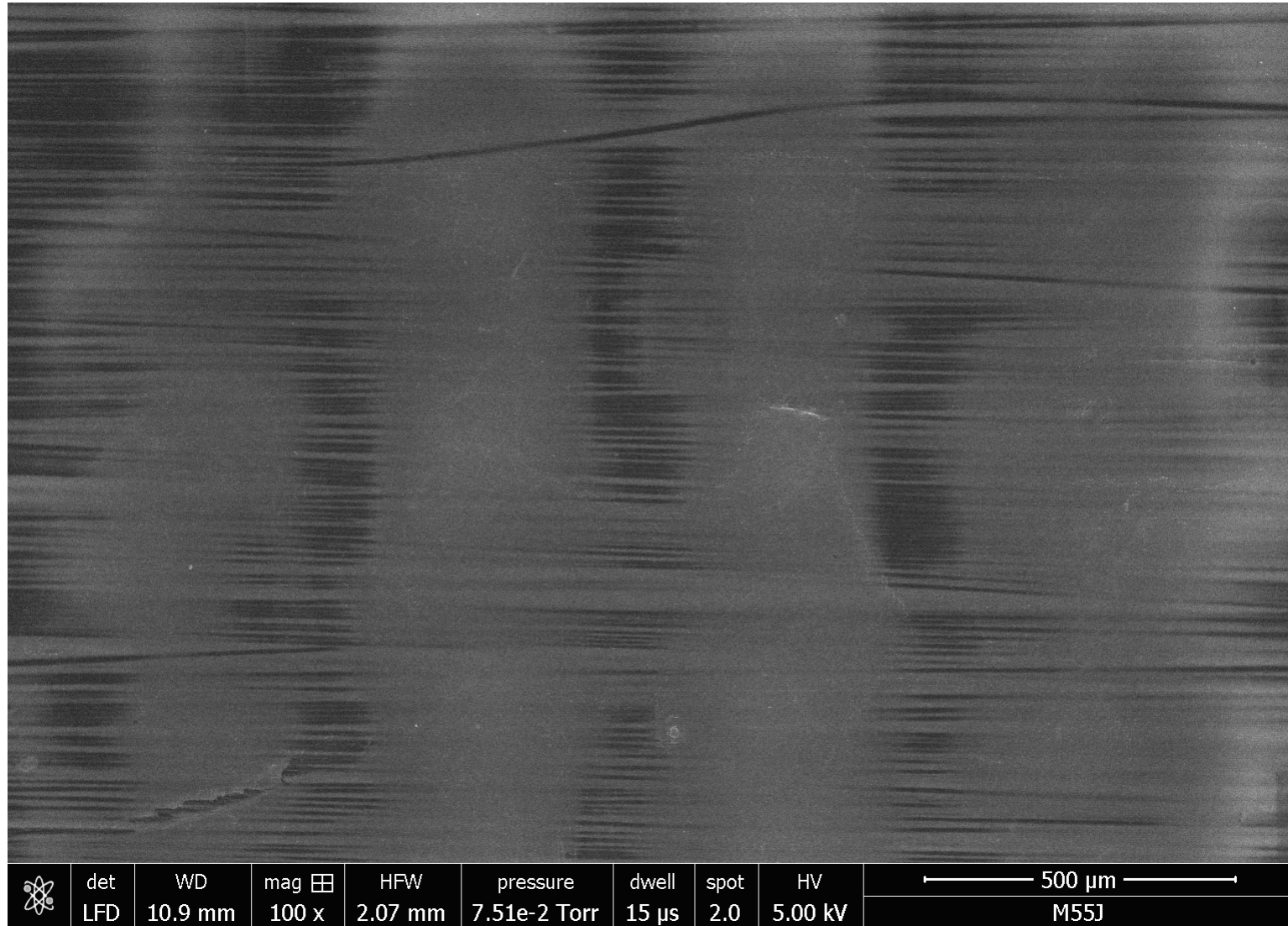
Comparison of Electron Yields



# Conclusion

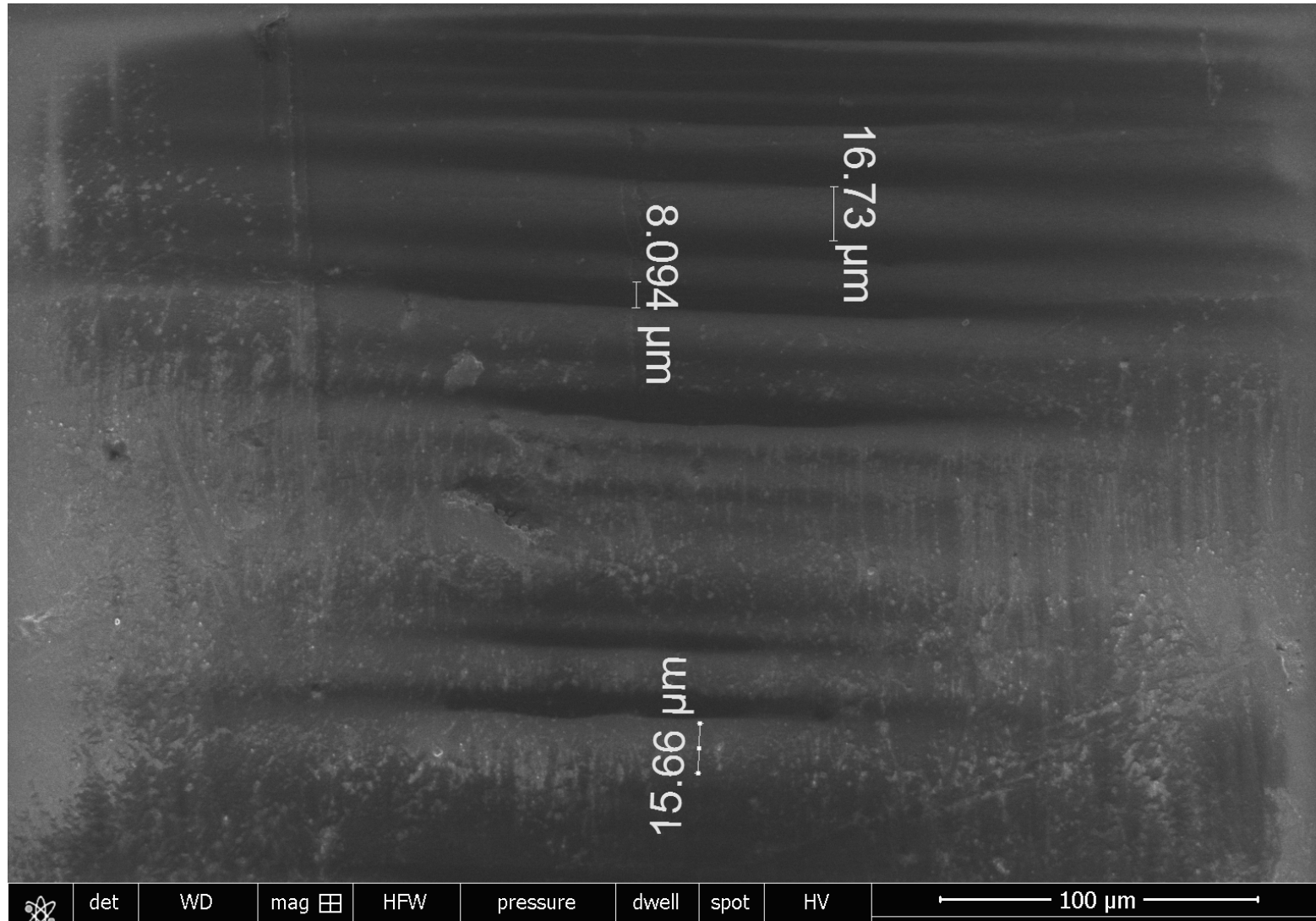
- Nano Scale structures and Geometry influence the Electron Yield
- The insulating Component (the Epoxy matrix) causes charging
- Our understanding of the individual components help us understand composite material Yield graphs

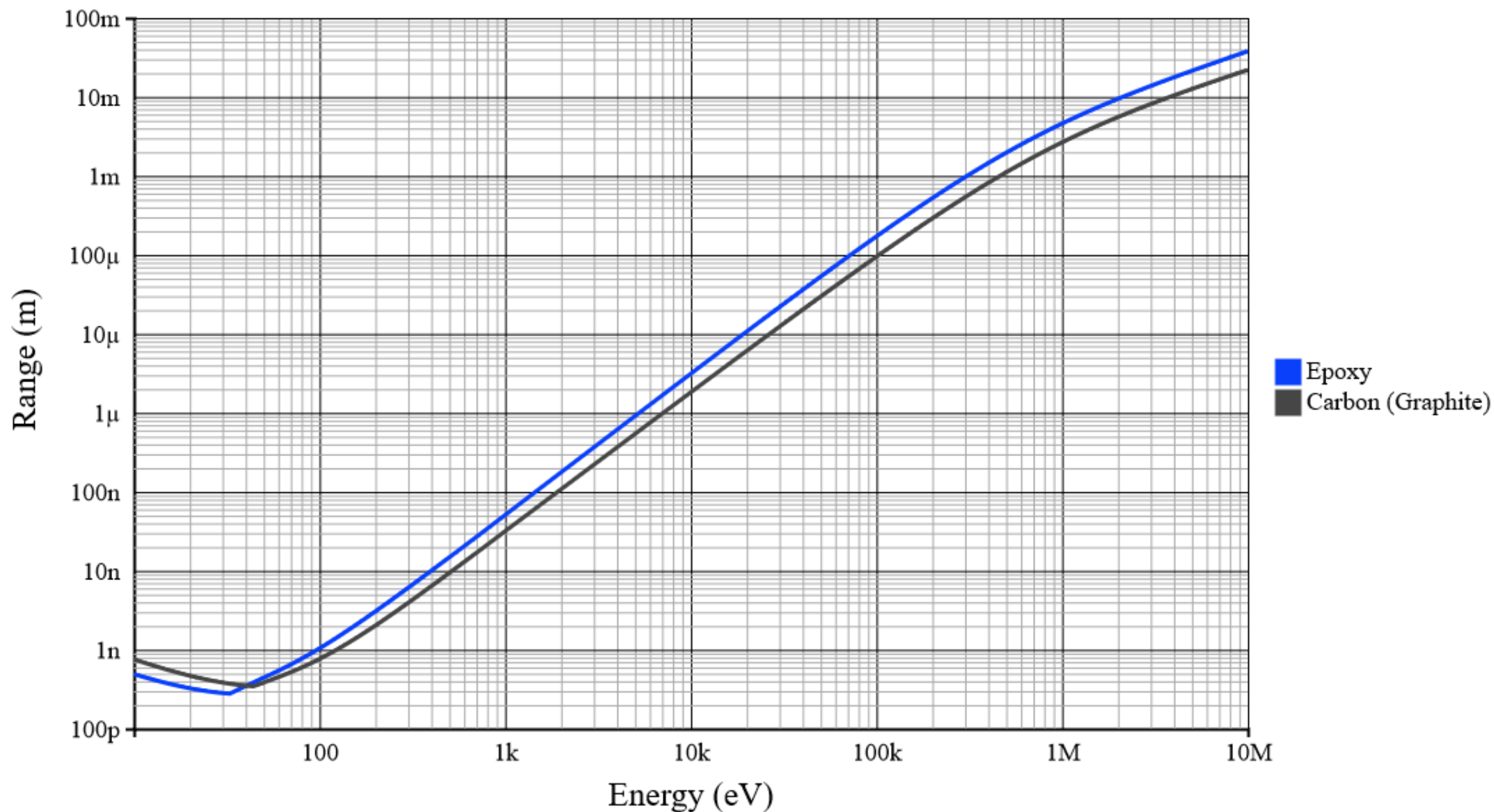
# SEM





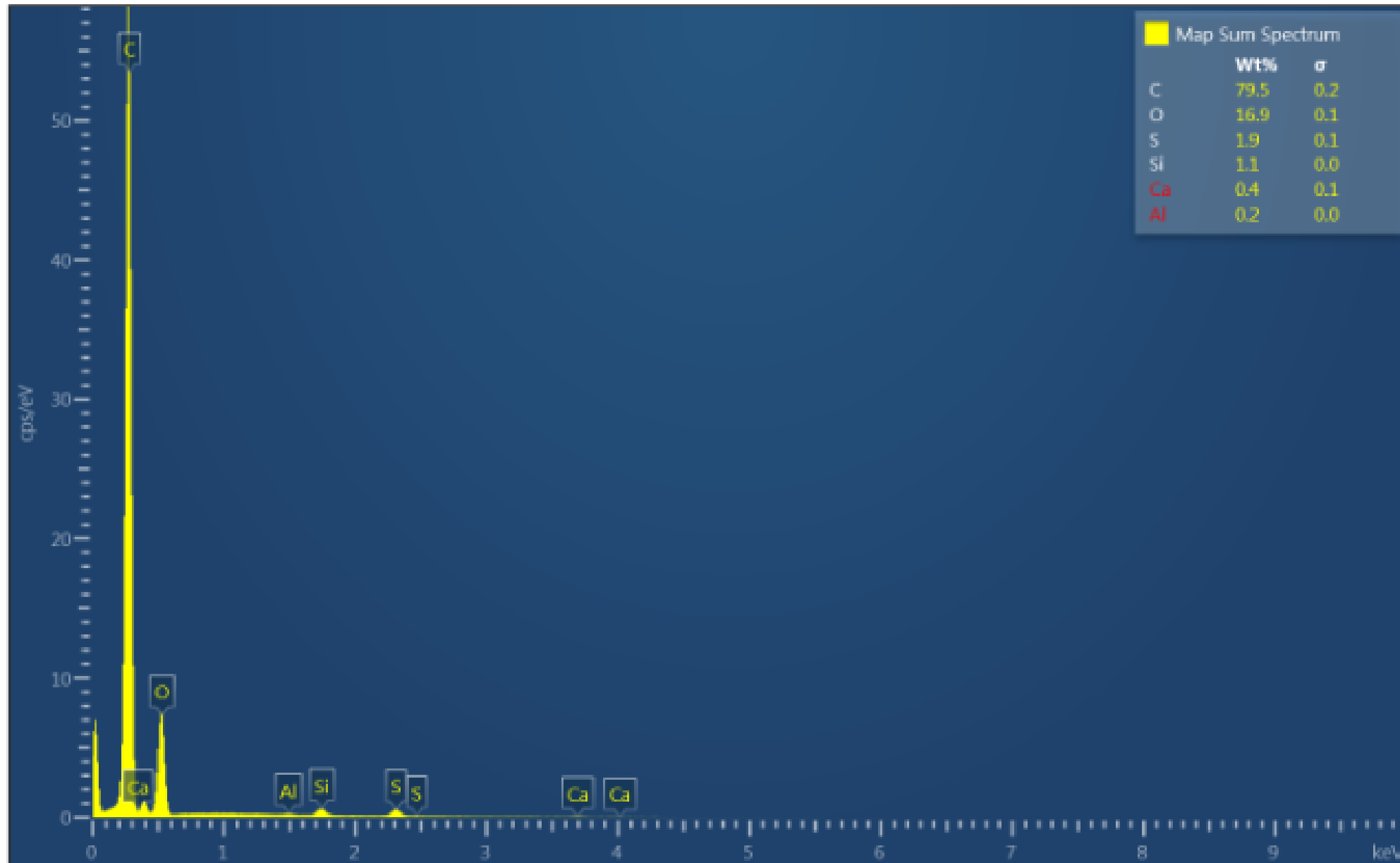
# SEM Continued





# Yield Features

|     |                       | M55J      | Epoxy      |
|-----|-----------------------|-----------|------------|
| TEY | $\sigma_{\text{Max}}$ | 2.5 ± 0.2 | 2.2 ± 0.3  |
|     | $E_{\text{max}}$      | 230 ± 80  | 256 ± 50   |
|     | $E_1$                 | 47 ± 1    | 45 ± 3     |
|     | $E_2$                 | 960 ± 400 | 1158 ± 200 |



## FUNCTIONAL PROPERTIES

|                              |   |
|------------------------------|---|
| CTE                          | -1.1 $\alpha \cdot 10^{-6}/^{\circ}\text{C}$      |
| Specific Heat                | 0.17 Cal/g $\cdot^{\circ}\text{C}$                |
| Thermal Conductivity         | 0.372 Cal/cm $\cdot\text{s}\cdot^{\circ}\text{C}$ |
| Electric Resistivity         | 0.8 $\times 10^{-3} \Omega\cdot\text{cm}$         |
| Chemical Composition: Carbon | >99 %   |
| Na + K                       | <50 ppm   |

## COMPOSITE PROPERTIES \*

|                      |          |                       |             |
|----------------------|----------|-----------------------|-------------|
| Tensile Strength     | 290 ksi  | 2,010 MPa             | ASTM D-3039 |
| Tensile Modulus      | 49.0 Msi | 340 GPa               | ASTM D-3039 |
| Tensile Strain       | 0.6 %    | 0.6 %                 | ASTM D-3039 |
| Compressive Strength | 130 ksi  | 880 MPa               | ASTM D-695  |
| Flexural Strength    | 180 ksi  | 1,230 MPa             | ASTM D-790  |
| Flexural Modulus     | 40.5 Msi | 280 GPa               | ASTM D-790  |
| ILSS                 | 10.0 ksi | 7 kgf/mm <sup>2</sup> | ASTM D-2344 |
| 90° Tensile Strength | 5.0 ksi  | 34 MPa                | ASTM D-3039 |

\* Toray 250°F Epoxy Resin. Normalized to 60% fiber volume.

## FIBER PROPERTIES

|                      | <b>English</b>            | <b>Metric</b>          | <b>Test</b>      |
|----------------------|---------------------------|------------------------|------------------|
| Tensile Strength     | 583 ksi                   | 4,020 MPa              | TY-0             |
| Tensile Modulus      | 78.2 Msi                  | 540 GPa                | TY-0             |
| Strain               | 0.8 %                     | 0.8 %                  | TY-0             |
| Density              | 0.069 lbs/in <sup>3</sup> | 1.91 g/cm <sup>3</sup> | TY-0             |
| Filament Diameter    | 2.0E-04 in.               | 5 $\mu\text{m}$        |                  |
| Yield                | 6K                        | 6,833 ft/lbs           | 218 g/1000m TY-0 |
| Sizing Type & Amount | 50B                       | 1.0 %                  | TY-0             |
|                      | Twist                     | Untwisted              |                  |