

## Molybdenum (IV) Dithiocarboxylates as Single-Source Precursors in CVD of MoS<sub>2</sub> Thin Films

Saleh Muhammad,<sup>a,b</sup> Erik T. Ferenczy,<sup>a</sup> Ian M. Germaine,<sup>a</sup> J. Tyler Wagner,<sup>a</sup> Muhammad T. Jan<sup>b</sup>  
and Lisa McElwee-White<sup>a,\*</sup>

<sup>a</sup>Department of Chemistry, University of Florida, Gainesville, FL 32611-7200 USA

<sup>b</sup>Department of Chemistry, Islamia College Peshawar, 25120 Peshawar, Pakistan

### Electronic Supplementary Information

#### Table of Contents

Name	Page Number
<b>Figure S-1.</b> <sup>1</sup> H NMR spectrum of Mo(S <sub>2</sub> CMe) <sub>4</sub> in C <sub>6</sub> D <sub>6</sub>	S-2
<b>Figure S-2.</b> <sup>13</sup> C{ <sup>1</sup> H} NMR spectrum of Mo(S <sub>2</sub> CMe) <sub>4</sub> in C <sub>6</sub> D <sub>6</sub>	S-2
<b>Figure S-3.</b> ESI-MS spectrum of Mo(S <sub>2</sub> CMe) <sub>4</sub> showing the [M] <sup>+</sup> ion	S-3
<b>Figure S-4.</b> <sup>1</sup> H NMR spectrum of Mo(S <sub>2</sub> CtEt) <sub>4</sub> in C <sub>6</sub> D <sub>6</sub>	S-4
<b>Figure S-5.</b> <sup>13</sup> C{ <sup>1</sup> H} NMR spectrum of Mo(S <sub>2</sub> CtEt) <sub>4</sub> in C <sub>6</sub> D <sub>6</sub>	S-4
<b>Figure S-6.</b> ESI-MS spectrum of Mo(S <sub>2</sub> CtEt) <sub>4</sub> showing the [M] <sup>+</sup> ion	S-5
<b>Figure S-7.</b> <sup>1</sup> H NMR spectrum of Mo(S <sub>2</sub> CPh) <sub>4</sub> in C <sub>6</sub> D <sub>6</sub>	S-6
<b>Figure S-8.</b> <sup>13</sup> C{ <sup>1</sup> H} NMR spectrum of Mo(S <sub>2</sub> CPh) <sub>4</sub> in C <sub>6</sub> D <sub>6</sub>	S-6
<b>Figure S-9.</b> ESI-MS spectrum of Mo(S <sub>2</sub> CPh) <sub>4</sub> showing the [M] <sup>+</sup> ion	S-7
<b>Figure S-10.</b> <sup>1</sup> H spectrum of crude Mo(S <sub>2</sub> C <sup>i</sup> Pr) <sub>4</sub> in C <sub>6</sub> D <sub>6</sub>	S-8
<b>Figure S-11.</b> <sup>13</sup> C{ <sup>1</sup> H} spectrum of crude Mo(S <sub>2</sub> C <sup>i</sup> Pr) <sub>4</sub> in C <sub>6</sub> D <sub>6</sub>	S-8
<b>Figure S-12.</b> ESI-MS spectrum of Mo(S <sub>2</sub> C <sup>i</sup> Pr) <sub>4</sub> showing the [M] <sup>+</sup> ion	S-9
<b>Figure S-13.</b> FE-SEM image of a film grown at 600 °C using Mo(S <sub>2</sub> CMe) <sub>4</sub> in toluene	S-10
<b>Figure S-14.</b> Raman spectra of a film grown at 600 °C using Mo(S <sub>2</sub> CMe) <sub>4</sub> in toluene	S-10

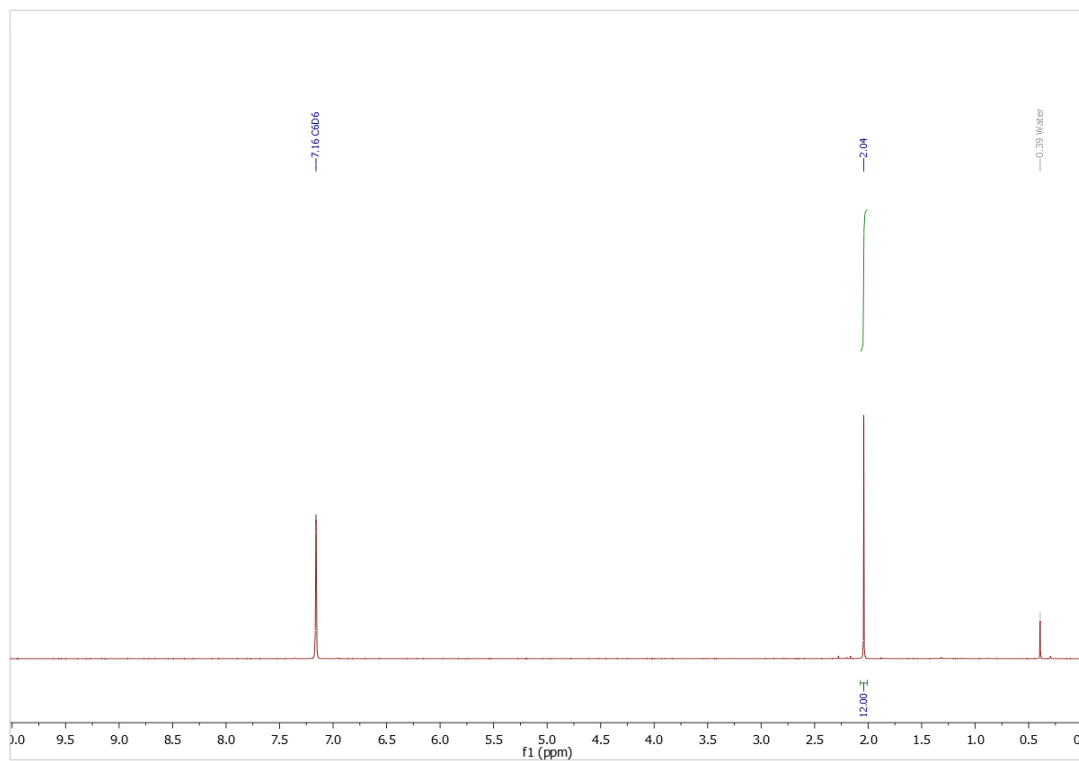


Figure S-1.  $^1\text{H}$  NMR spectrum of  $\text{Mo}(\text{S}_2\text{CMe})_4$  in  $\text{C}_6\text{D}_6$ .

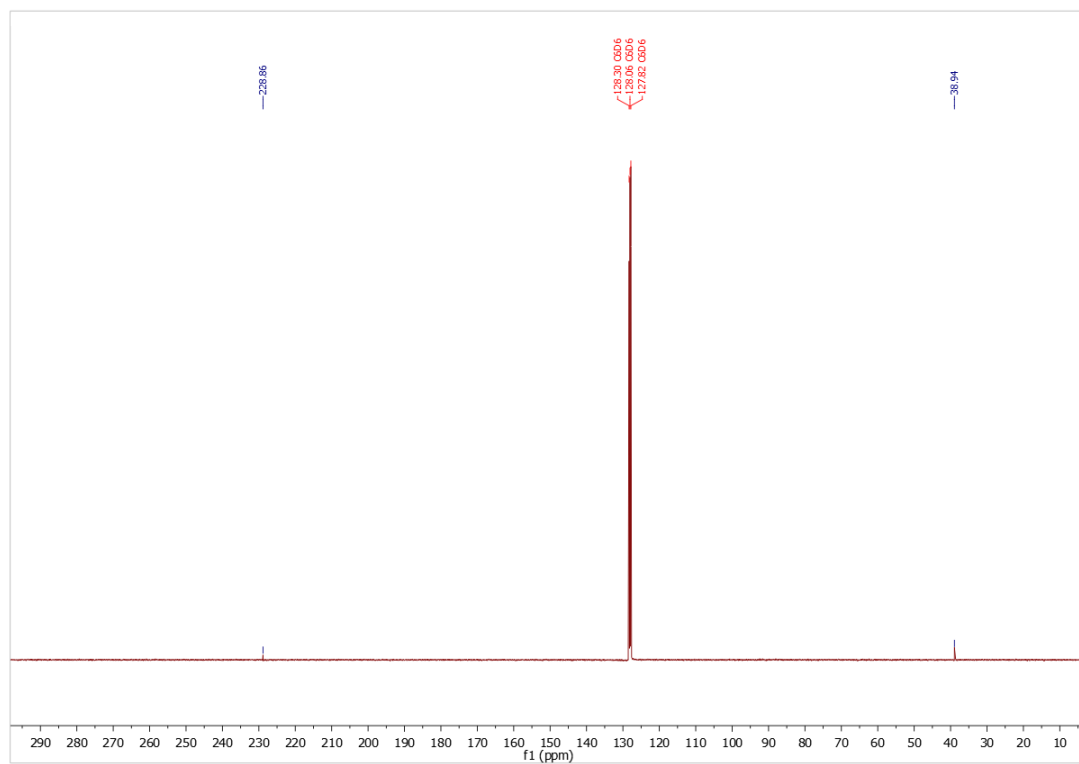


Figure S-2.  $^{13}\text{C}\{^1\text{H}\}$  NMR spectrum of  $\text{Mo}(\text{S}_2\text{CMe})_4$  in  $\text{C}_6\text{D}_6$ .

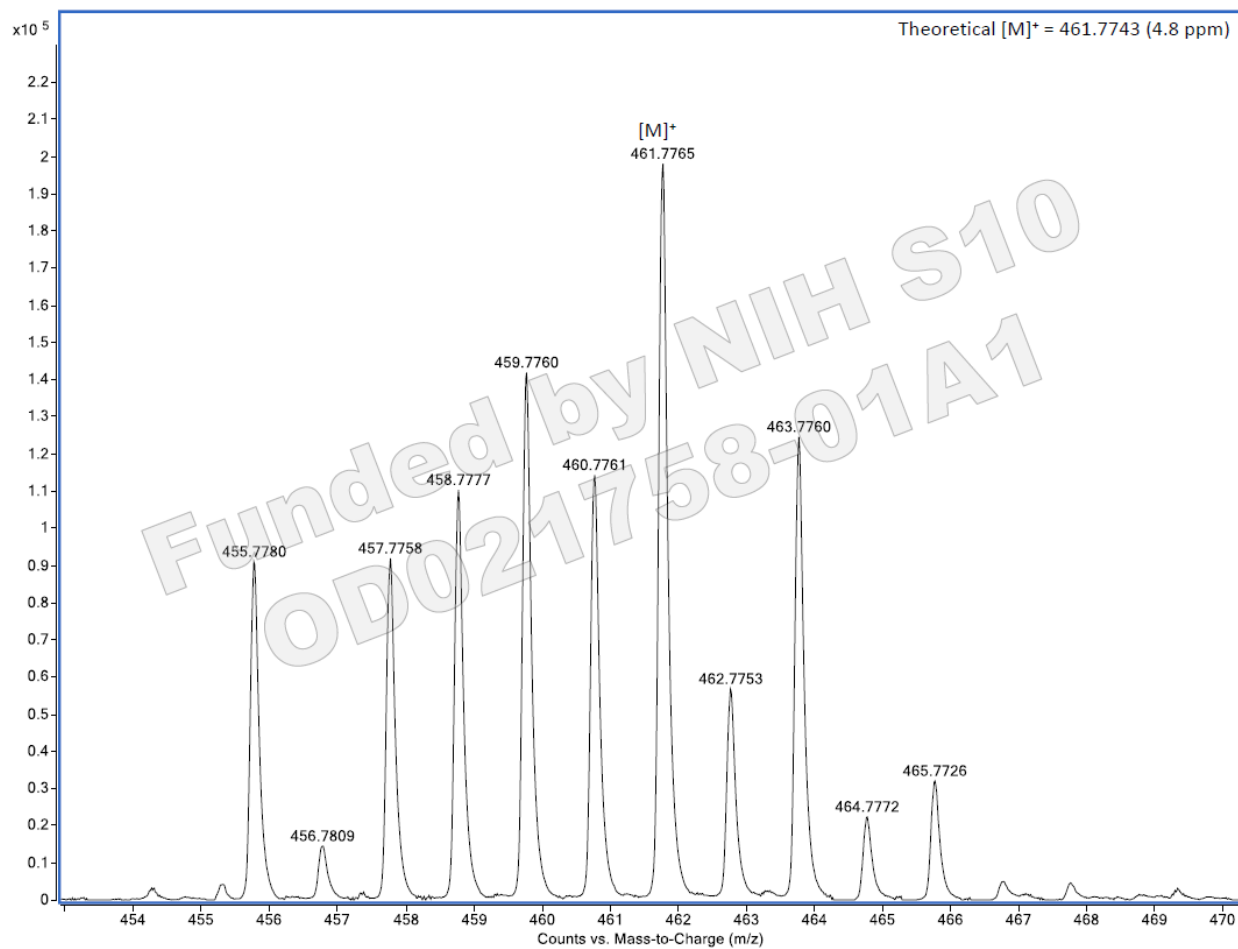


Figure S-3. ESI-MS spectrum of Mo(S<sub>2</sub>CMe)<sub>4</sub> showing the [M]<sup>+</sup> ion.

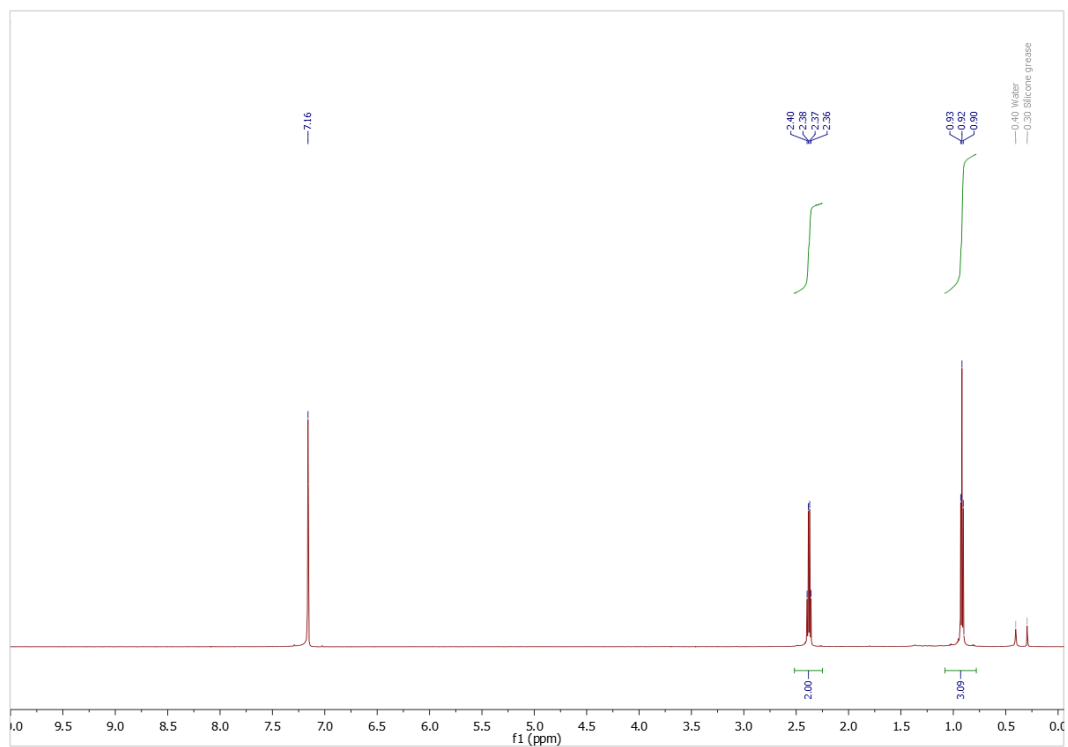


Figure S-4.  $^1\text{H}$  NMR spectrum of  $\text{Mo}(\text{S}_2\text{CET})_4$  in  $\text{C}_6\text{D}_6$ .

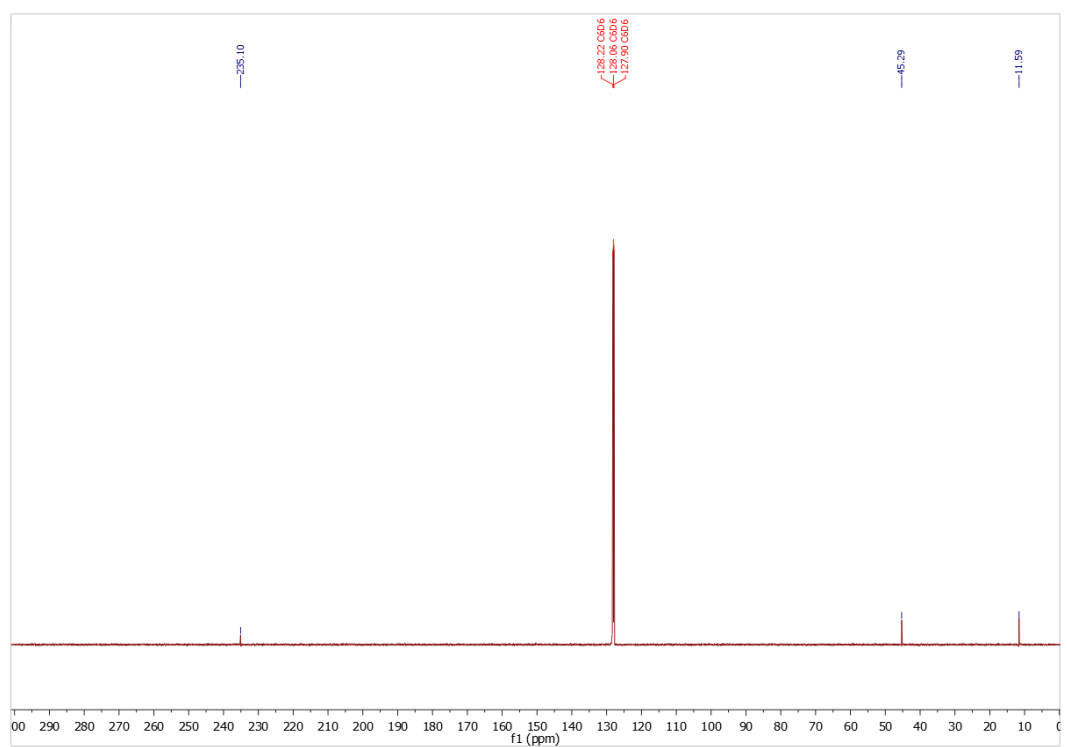


Figure S-5.  $^{13}\text{C}\{^1\text{H}\}$  NMR spectrum of  $\text{Mo}(\text{S}_2\text{CET})_4$  in  $\text{C}_6\text{D}_6$ .

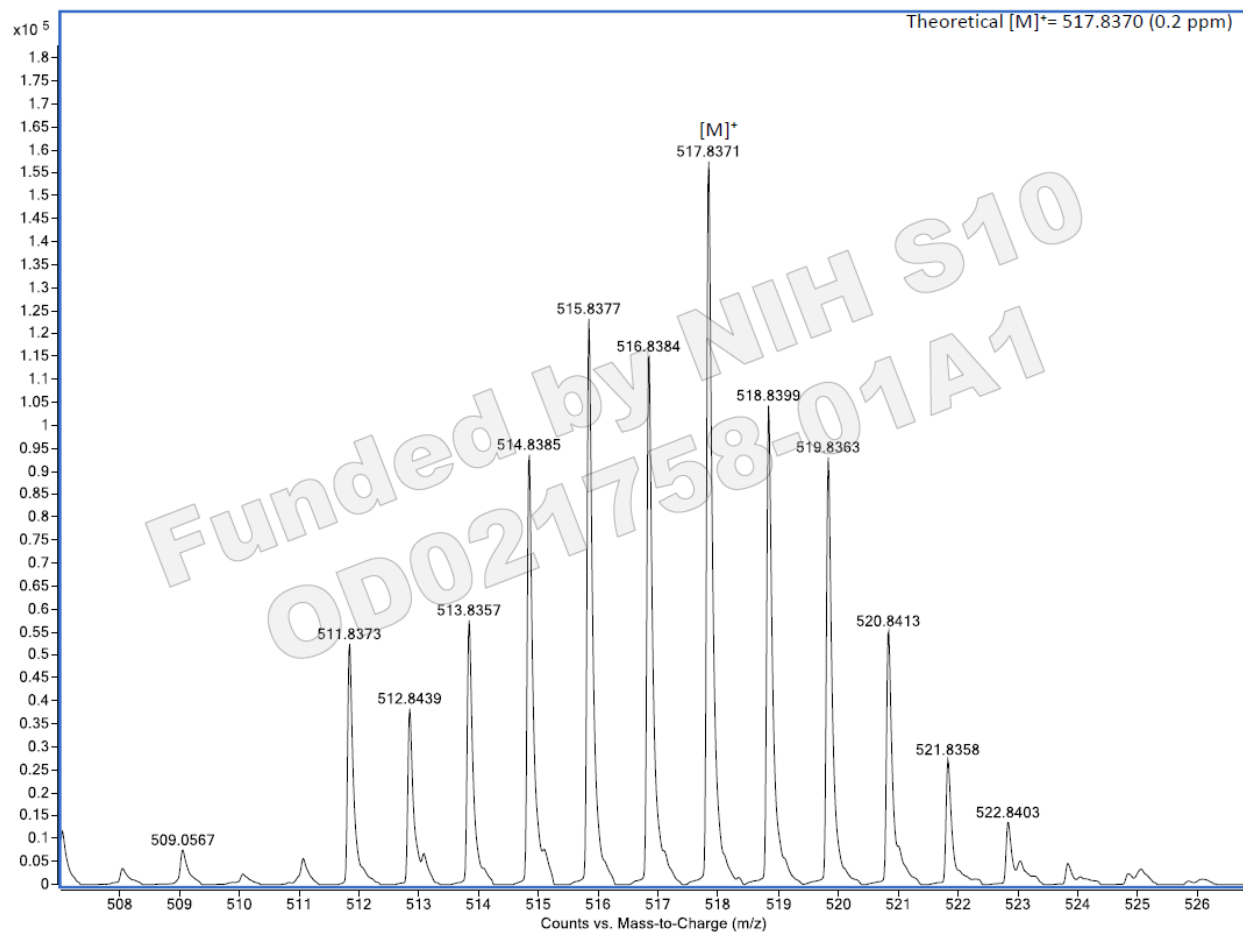


Figure S-6. ESI-MS spectrum of  $\text{Mo}(\text{S}_2\text{CET})_4$  showing the  $[\text{M}]^+$  ion.

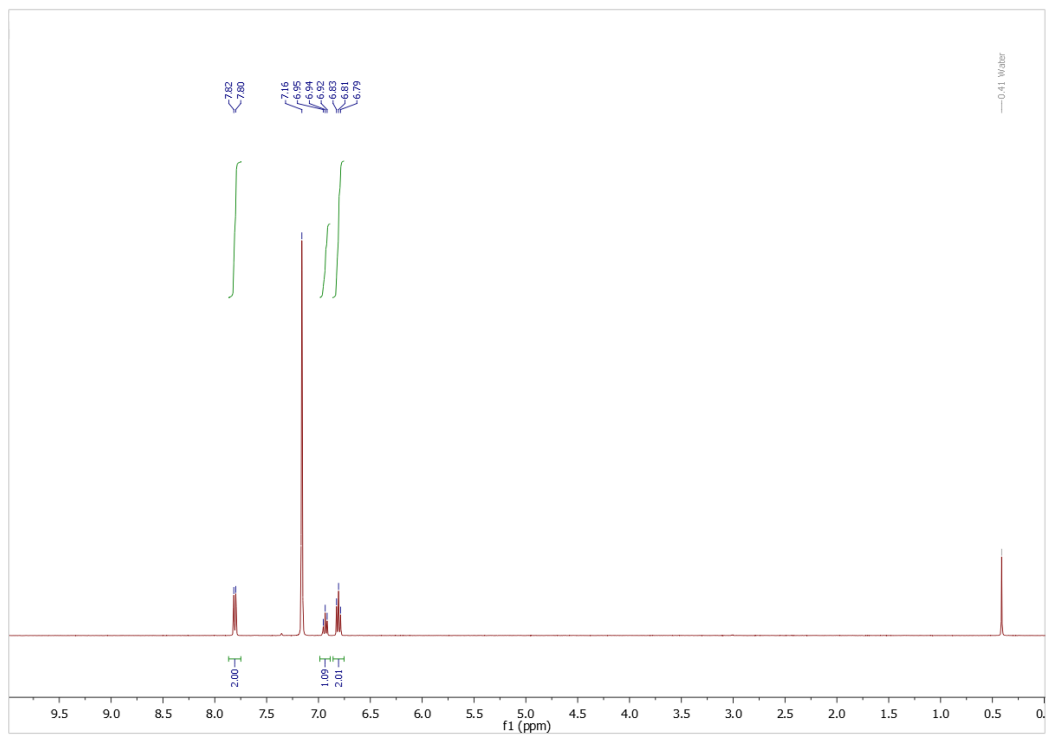


Figure S-7.  $^1\text{H}$  NMR spectrum of  $\text{Mo}(\text{S}_2\text{CPh})_4$  in  $\text{C}_6\text{D}_6$ .

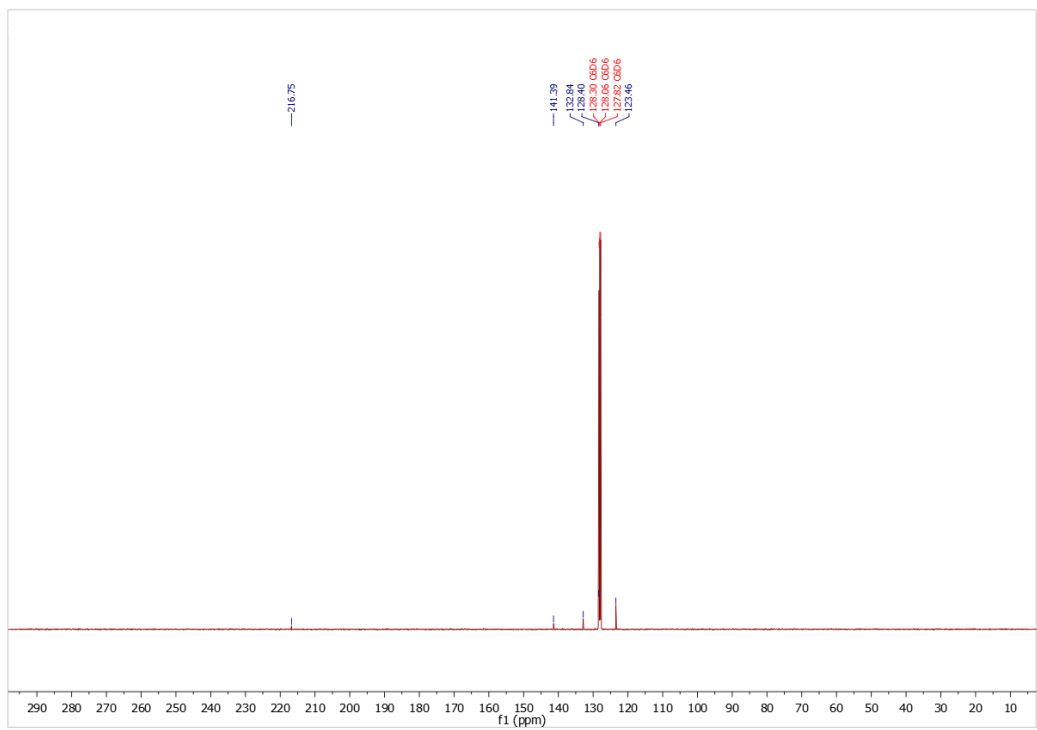


Figure S-8.  $^{13}\text{C}\{^1\text{H}\}$  NMR spectrum of  $\text{Mo}(\text{S}_2\text{CPh})_4$  in  $\text{C}_6\text{D}_6$ .

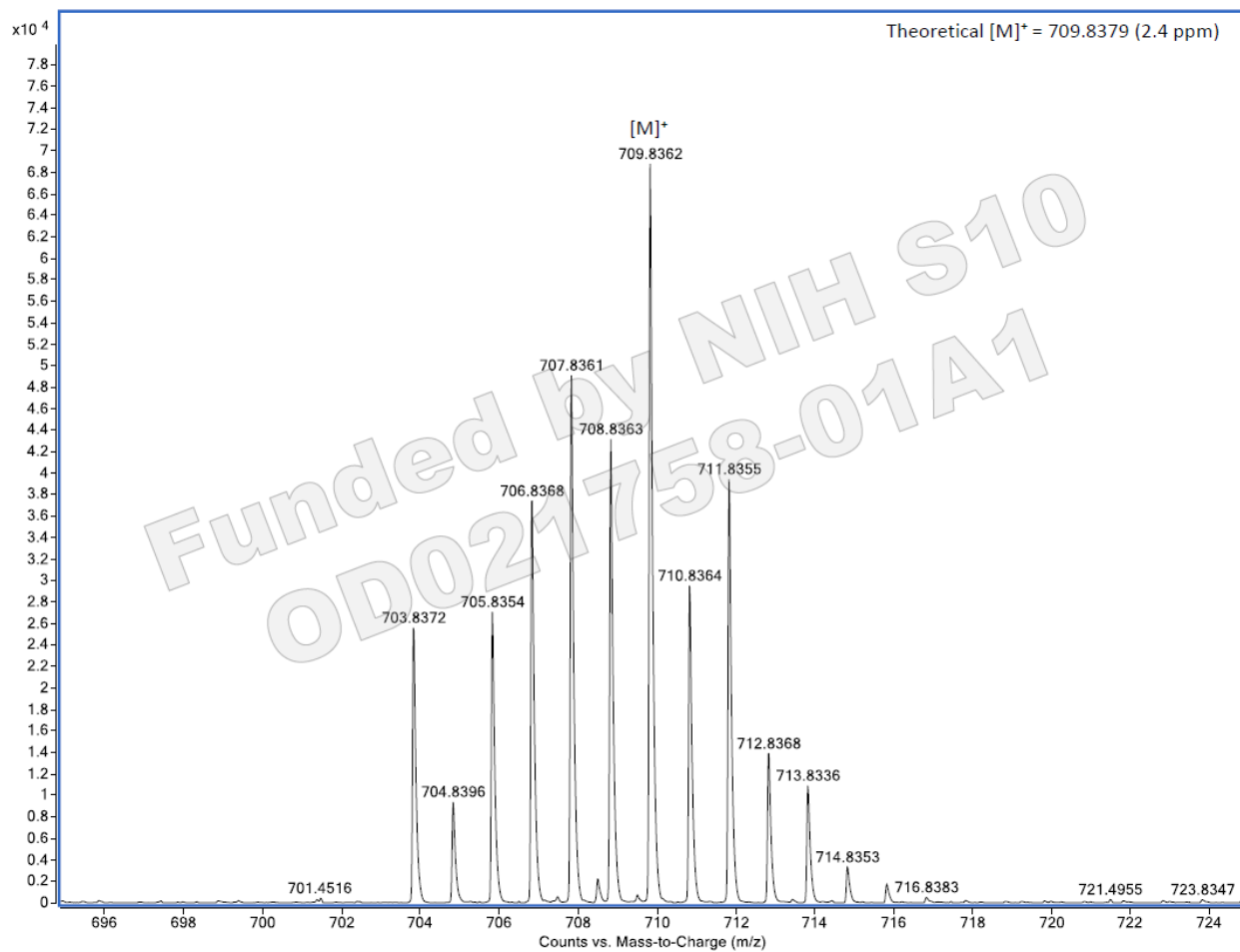


Figure S-9. ESI-MS spectrum of Mo(S<sub>2</sub>CPh)<sub>4</sub> showing the [M]<sup>+</sup> ion.

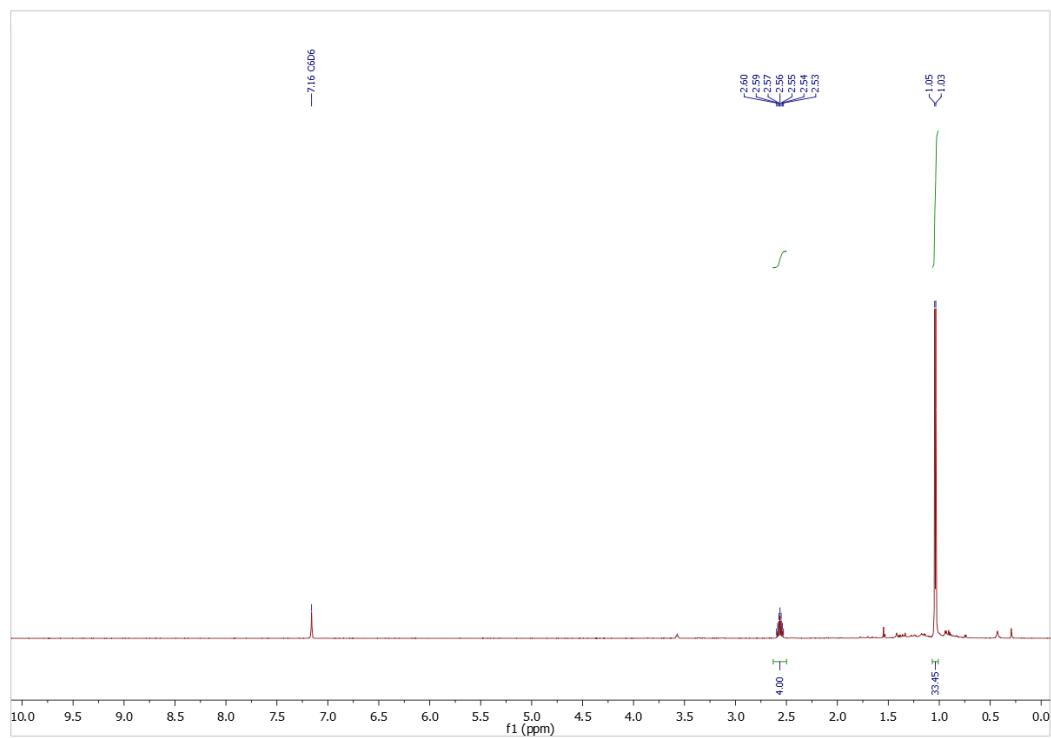


Figure S-10.  $^1\text{H}$  spectrum of crude  $\text{Mo}(\text{S}_2\text{C}^i\text{Pr})_4$  in  $\text{C}_6\text{D}_6$ .

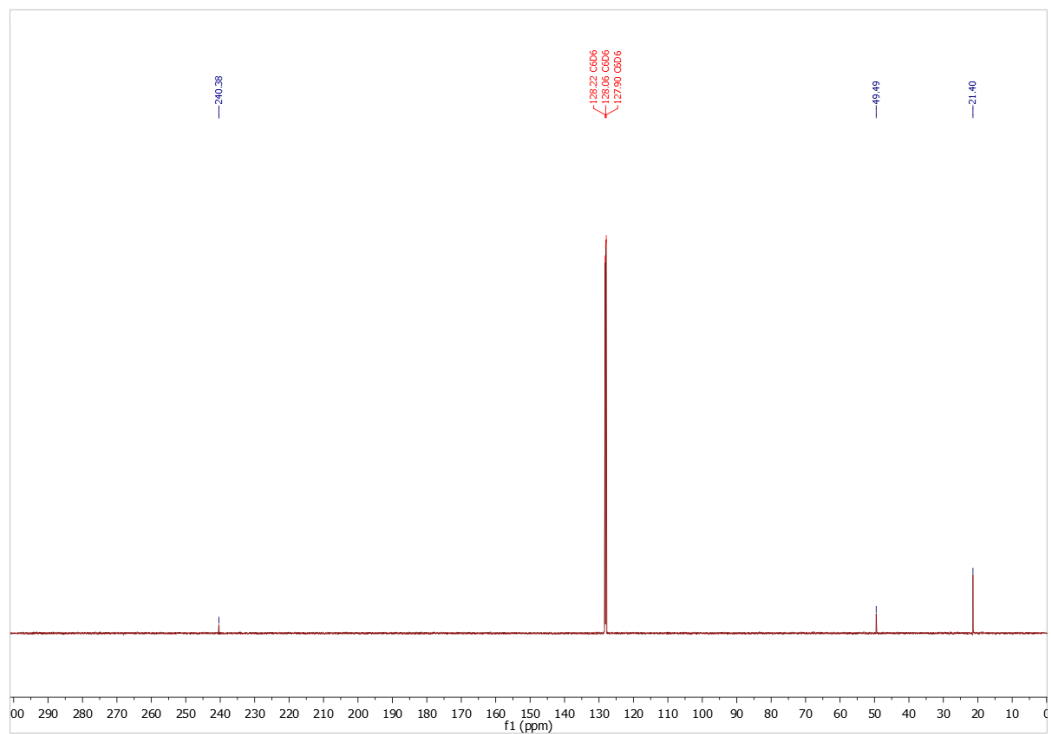


Figure S-11  $^{13}\text{C}\{^1\text{H}\}$  spectrum of crude  $\text{Mo}(\text{S}_2\text{C}^i\text{Pr})_4$  in  $\text{C}_6\text{D}_6$ .



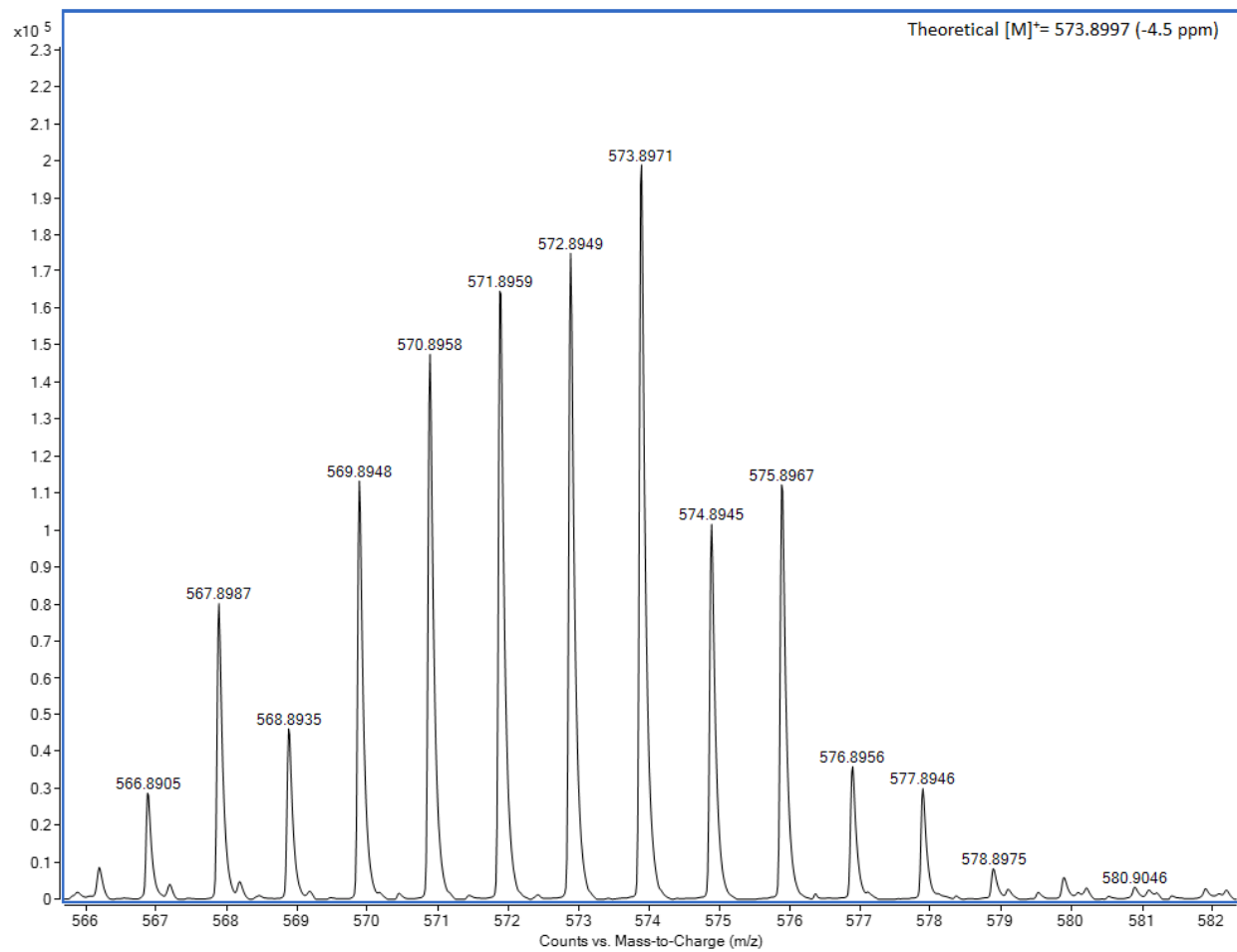


Figure S-12. ESI-MS spectrum of  $\text{Mo}(\text{S}_2\text{C}^i\text{Pr})_4$  showing the  $[M]^+$  ion.

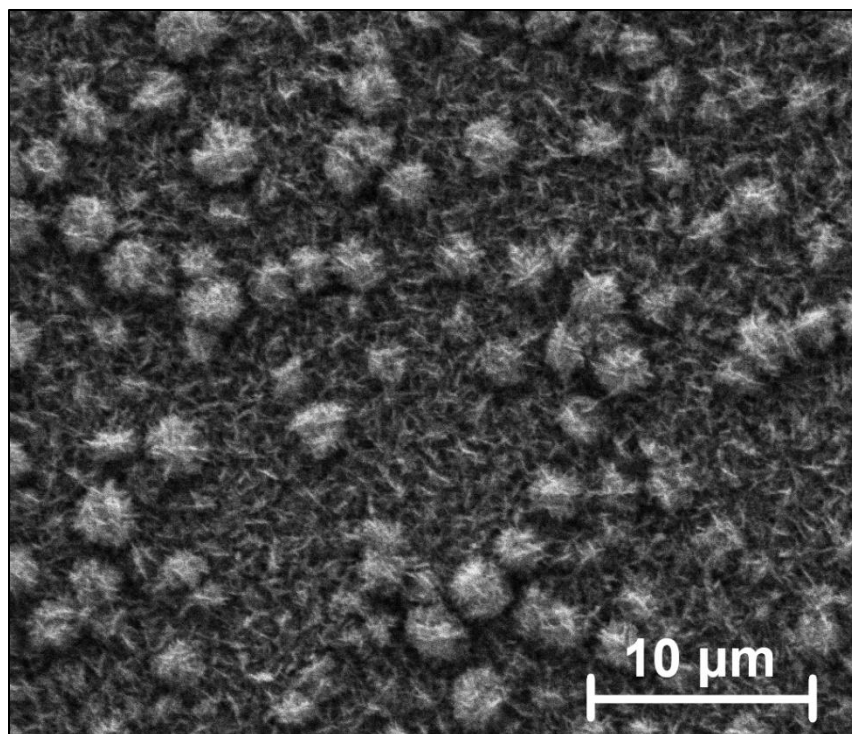


Figure S-13. FE-SEM image of a film grown at 600 °C using  $\text{Mo}(\text{S}_2\text{CMe})_4$  in toluene.

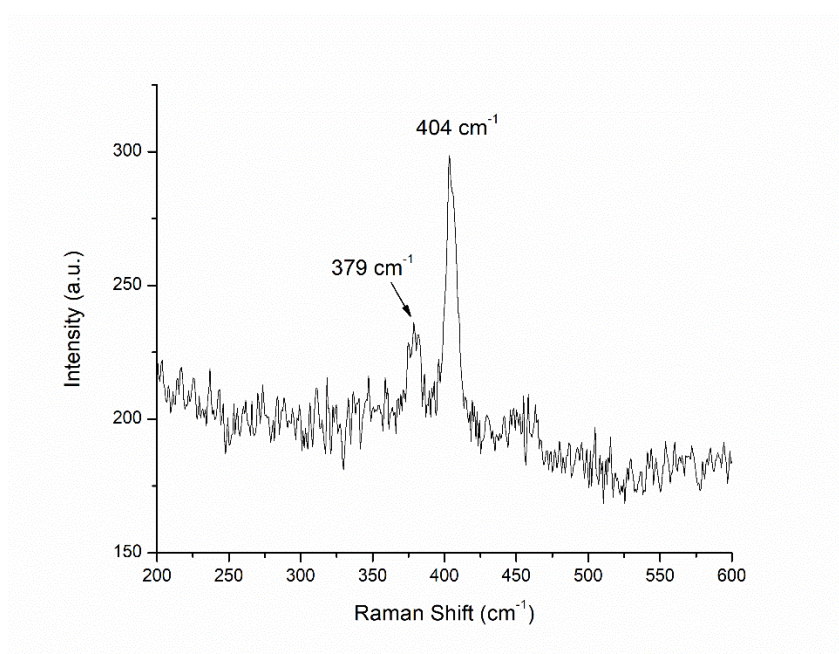


Figure S-14. Raman spectra of a film grown at 600 °C using  $\text{Mo}(\text{S}_2\text{CMe})_4$  in toluene.