Enhancing the Cyanoacrylate Fuming Method of Latent Prints via Coupling the Effects of Temperature and Humidity

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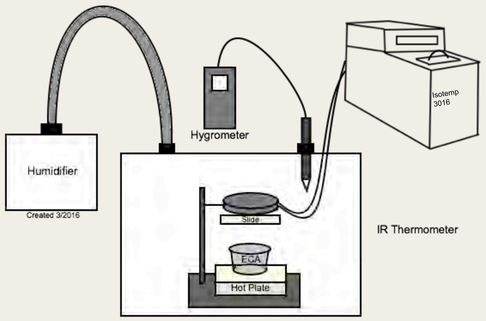
Introduction

- Fingerprints are one of the most trusted pieces of physical evidence in criminal investigations.
- The fuming of ethyl cyanoacrylate (ECA) on fingerprints develops prints.
- Fuming involves anionic polymerization of ECA from print surface.
- Low temperatures produces a larger quantity of high molecular weight polymer.
- *A more complete understanding of the combined effects of humidity and temperature on the growth of poly(ECA) on fingerprints during fuming is needed.*

Experimental Design

- Coupled effects of humidity and temperature studied by fuming latent prints on glass slides at different humidity levels and temperatures.
- The effect of fuming time on the quality of fingerprints was also examined.
- Experiments conducted in a fuming tank



Analyses

- Mass analysis – Balance (Scale)
  - Determine amount of poly(ECA) formed
- Gel Permeation Chromatography – M_n and M_w
  - Determined molecular weight characteristics of the polymer

Results

Temperature Effects

Figure 1: Photos of slides after fuming at surface temperatures from -10 to 25 ºC at 50% (left) and 80% (right) relative humidity.

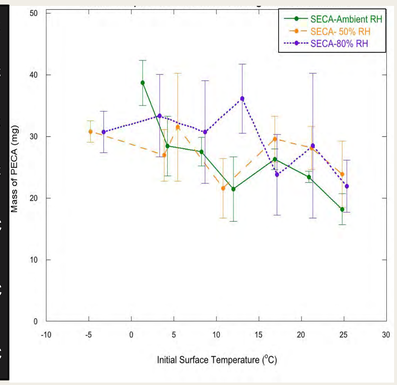


Figure 2: Average mass of poly (ethyl cyanoacrylate) on glass slides after fuming at surface temperatures ranging from -10 to 25 ºC at ambient, 50%, and 80% relative humidity.

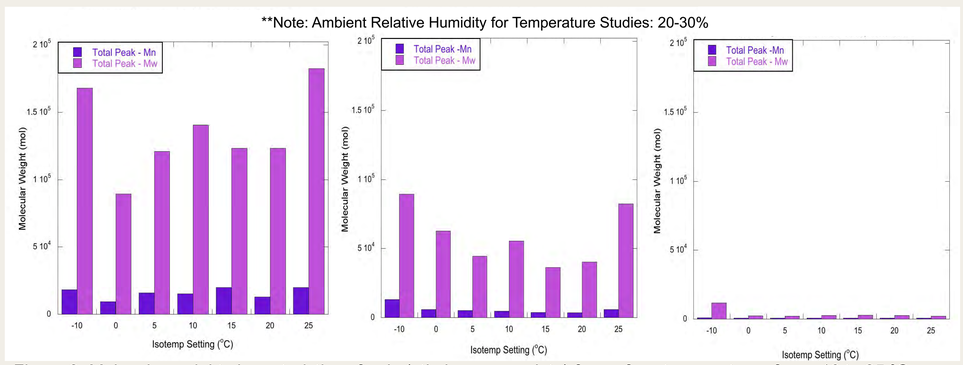


Figure 3: Molecular weight characteristics of poly (ethyl cyanoacrylate) for surface temperatures from -10 to 25 ºC when fuming at ambient (left), 50% (middle), and 80% (right) relative humidity.

Time Evolution of Polymer

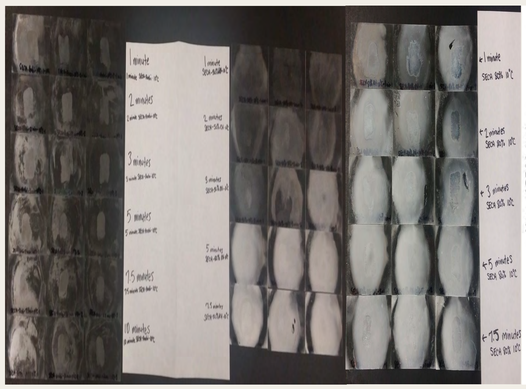
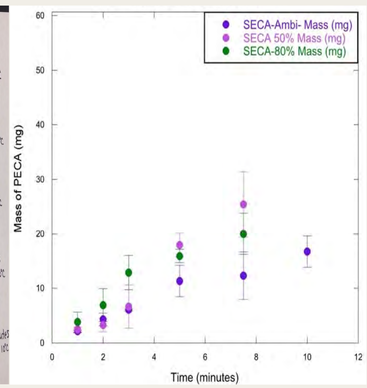


Figure 4: Photos of slides after fuming at a surface temperature of 10 ºC at ambient (left), 50% (middle) and 80% (right) relative humidity over time.



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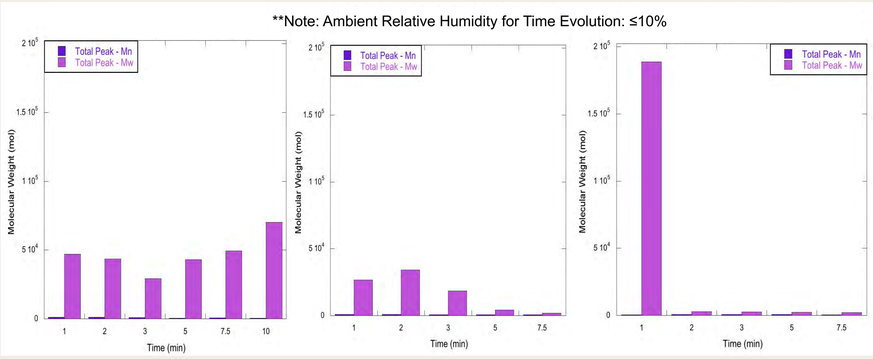

Figure 6: Molecular weight characteristics of poly (ethyl cyanoacrylate) as a function of fuming time for surface temperature of 10 ºC when fuming at ambient (left), 50% (middle), and 80% (right) relative humidity.

Discussion – Temperature Studies

- Higher humidity produces a larger mass of PECA. This higher mass is due to background polymerization and a larger amount of lower molecular weight polymer.
- At lower temperature (-10 → 25 °C), increased humidity decreases the molecular weight of the polymer, with little change in the mass of polymer formed.
- At ambient relative humidity, there is more higher molecular weight PECA for all temperatures.

Discussion – Time Studies

- As time and humidity increase, there is a higher occurrence of background polymerization. There is very little background polymerization for fuming under ambient relative humidity.
- Overall, the cyanoacrylate fuming method carried out under ambient relative humidity produces the optimum contrast for the latent fingerprints and more higher molecular weight PECA.

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Acknowledgements:

NIJ | National Institute of Justice

NIJ Grant: 2015-IJ-CX-K015

PEER

Program for Excellence and Equity in Research

NIH grant: PEER 5R256MO86761-06

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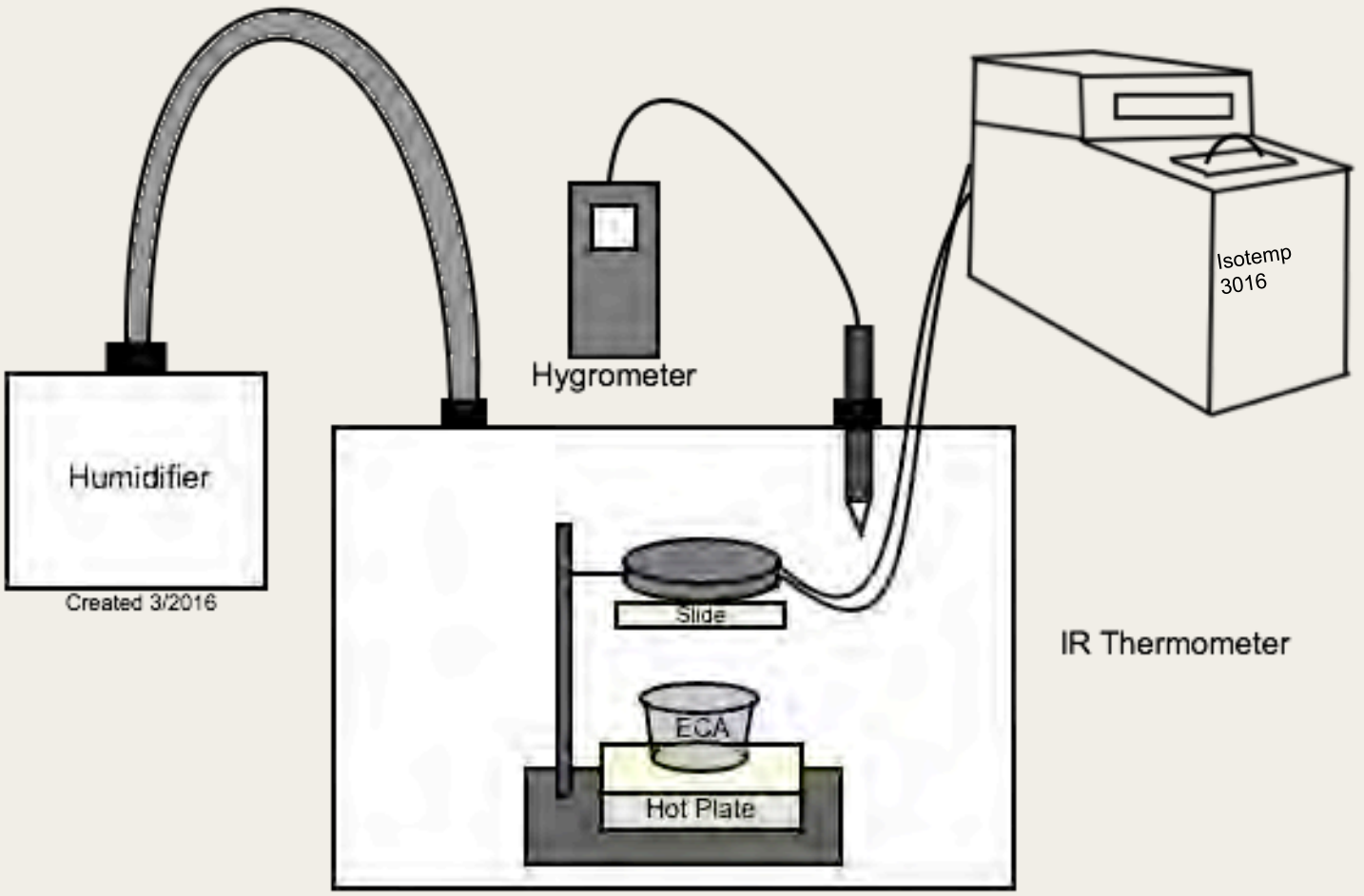

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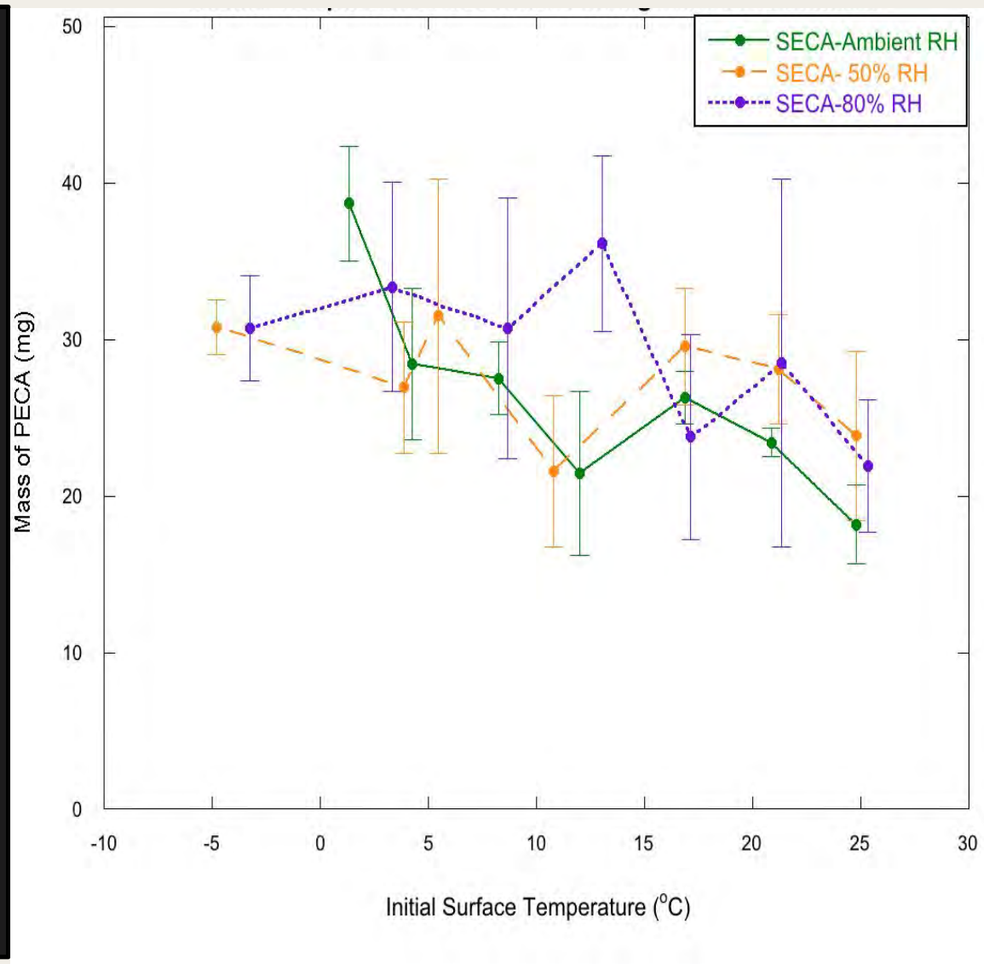

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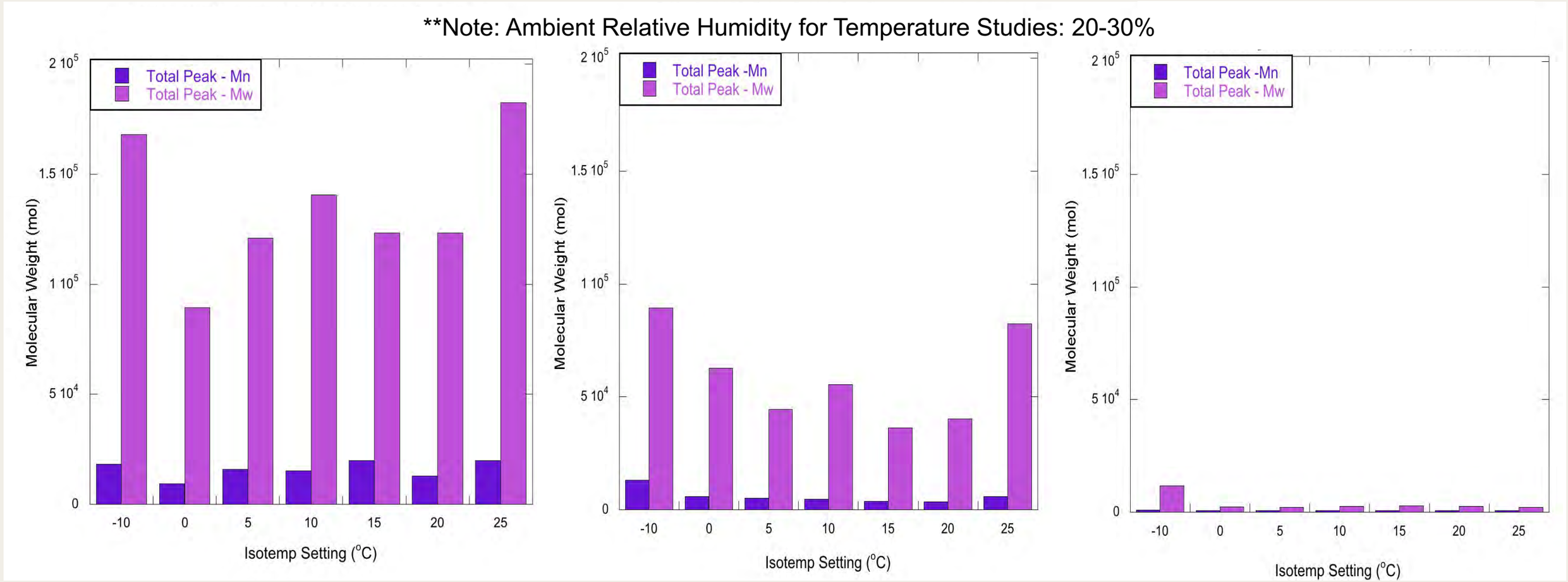

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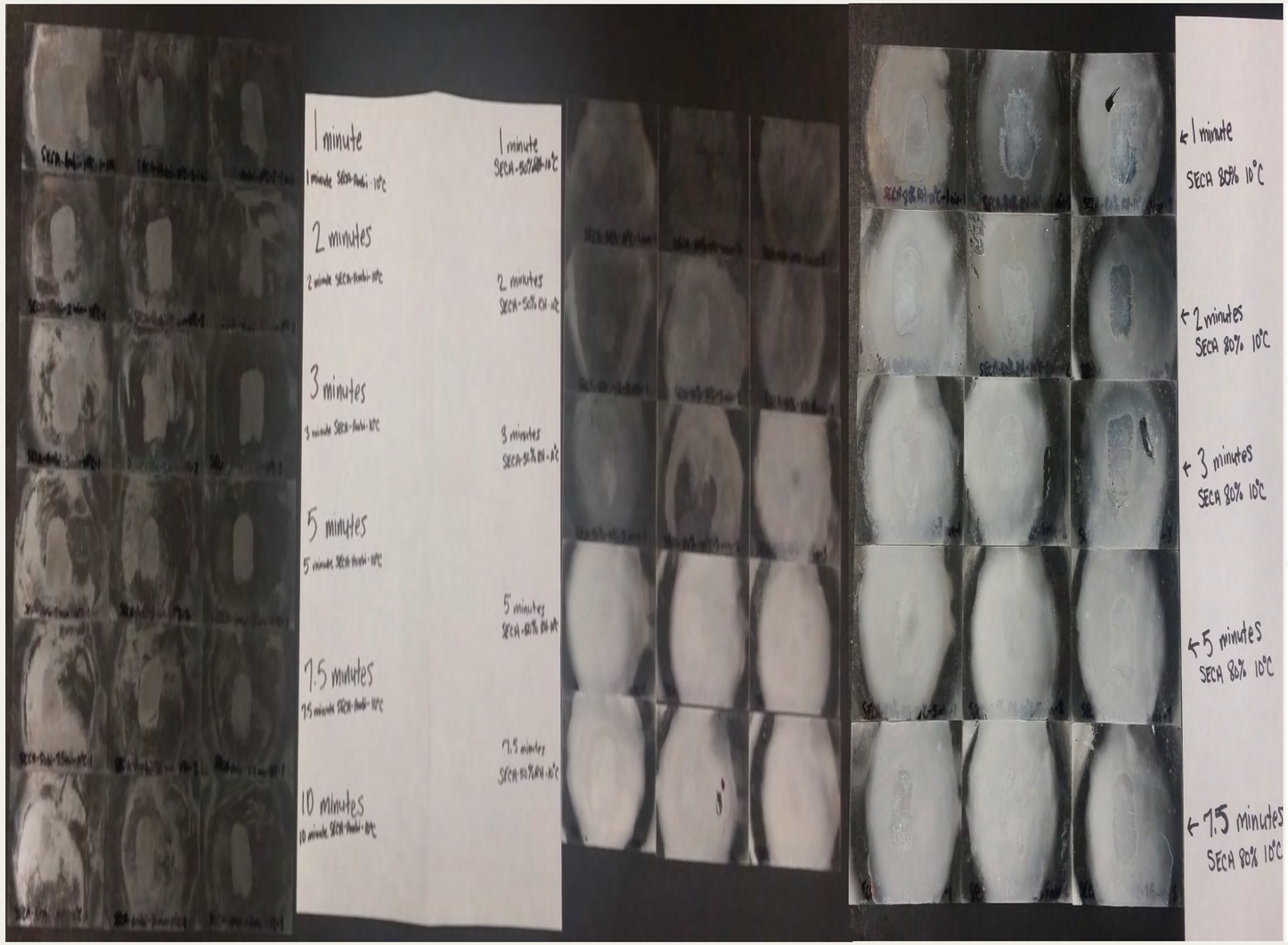

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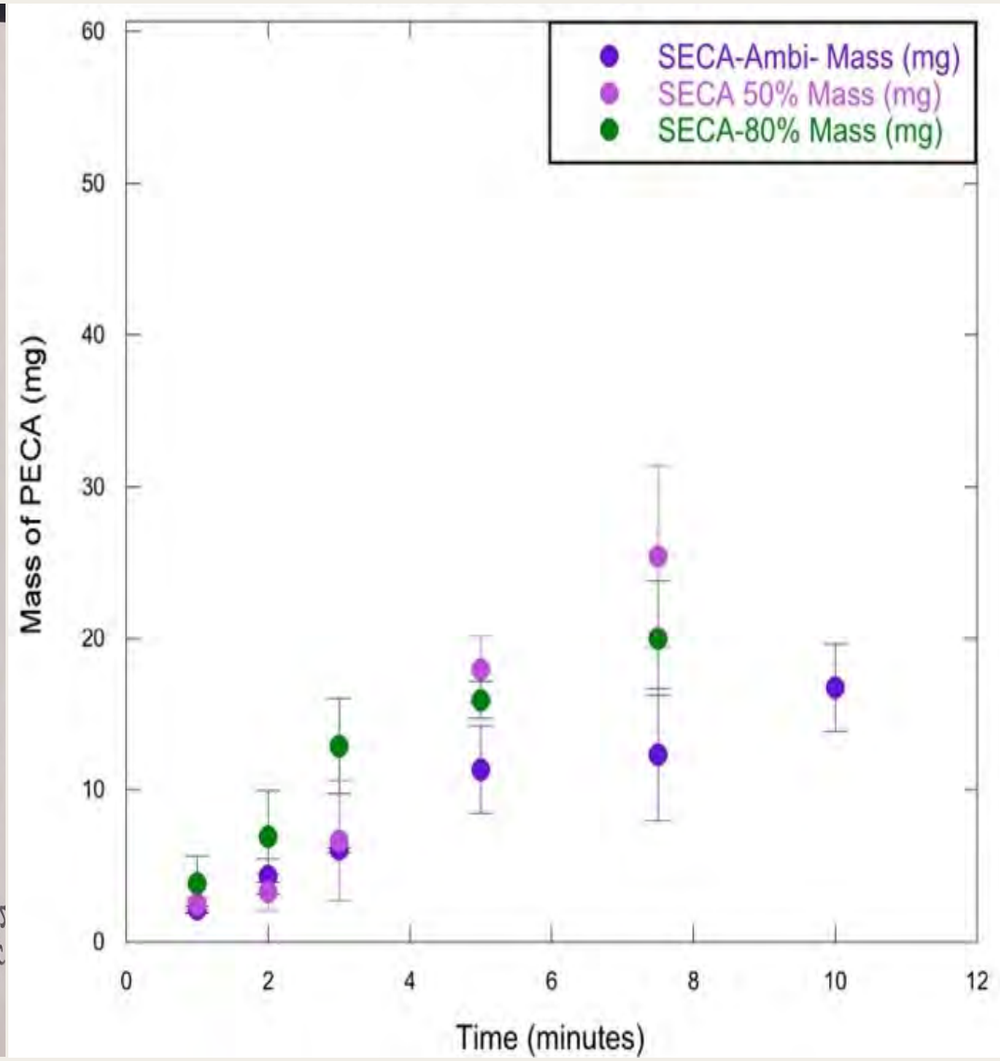

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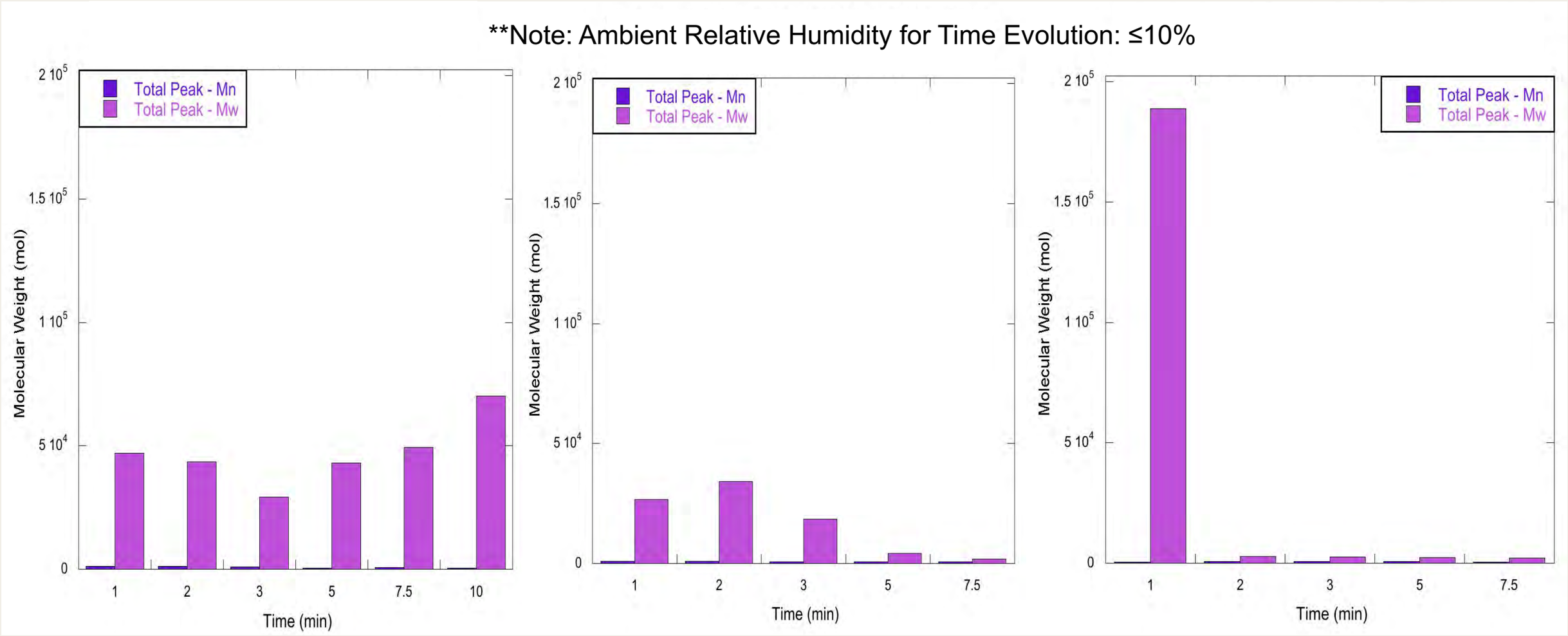

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