LEVERAGING ISOTOPIC LABELS TO ELUCIDATE THE THERMAL-OXIDATIVE DEGRADATION MECHANISMS OF NYLON 6.6

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By leveraging isotopic labels in conjunction with cryo-GC/MS analysis, we have identified several key thermal-oxidative degradation species of nylon 6.6, including CO_2, NH_3, water, cyclopentanone, and pyridine.[1] Identification of these products (labeled and unlabeled) was pertinent in elucidating the origins and underlying degradation pathways that lead to their formation. To our knowledge, this work is the first account that quantitatively distinguishes oxygen containing degradation species originating from the polymer backbone and oxygen species coming from the ambient air during the oxidation process.[2] The methodologies employed here may be extended to other polymers and likely leveraged towards future sensor development to provide condition monitoring of aging materials.

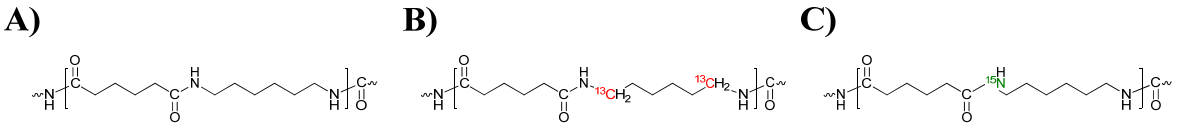

Figure 1. Schematic of Nylon 6.6 (A) unlabeled and (B) enriched with 13C or (C) 15N isotopic labels positioned in the 1,6-hexanediamine fragment employed in our aging studies.

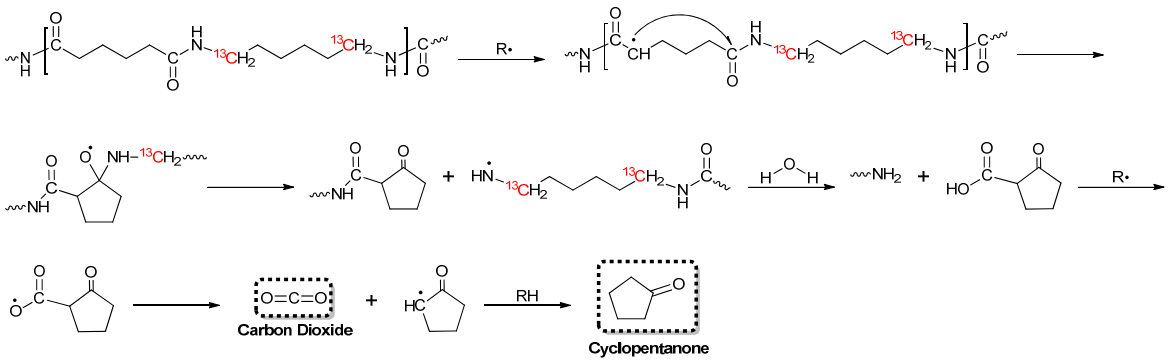

Figure 2. One possible thermal-oxidative degradation mechanism of nylon 6.6 within the nylon backbone that leads to the formation of cyclopentanone; alternatives may exist, e.g. the removal of the carboxylic group through a non-radical reaction.

Acknowledgement

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References

1. Smith J., White II G. V., Bernstein R., Hochrein J. M., J. Am. Soc. Mass. Spectrom. *Accepted*, 2012.

2. White II G. V., Smith J., Clough R. L., Ohlhausen J. A., Hochrein J. M., Poly. Deg. Stab. *Accepted* 2012. DOI: 10.1016/j.polymdegradstab.2012.05.018