Synthesis of Monodisperse Dendritic Calibrants for Improved Mass Spectrometry Accuracy

Kristin Fuller, Joseph A. Giesen, Scott M. Grayson

1 Department of Materials Science & Engineering, Clemson University, Clemson, SC 29632
2 Department of Chemistry, Tulane University, New Orleans, LA 70118

Abstract

Of the numerous mass spectrometry techniques available, matrix-assisted laser desorption/ionization time-of-flight-mass spectrometry (MALDI-ToF MS) is perhaps the most accurate method for determining the overall molecular weight distribution of synthetic polymers. Because of its sensitivity, frequent calibration is required to produce these accurate results. Traditional calibrants used for MALDI-ToF are peptides and proteins because of their monodispersity, but they are often unstable and difficult and expensive to synthesize. Thus, our aim is to develop stable, soluble, and inexpensive alternatives that provide us with similarly accurate results.

Dendrimers based on 2,2-bis(cholesteryl)propionic acid (bis-MPA) have proved to be desirable alternative MS calibrants. Dendrimers are monodisperse, perfectly branched polymers with functional groups that increase exponentially as generations increase. With higher generation dendrimers (3rd-5th), we can develop calibrants with long shelf-lives that are compatible with a wide range of matrices and instruments than their protein and peptide counterparts. These dendrimer calibrants provide calibrations across the range of 700-30,000 u, giving us the ability to analyze polymers across a vast array of functional groups that increase exponentially as generations increase.

Conclusion and Future Work

Dendrimers with four different cores—tris, tetra, penta, and hexa—were synthesized, with the tris and tetra cores providing the most results as they were each taken to the third generation. Results show that these dendrimers are monodisperse and, because of MALDI-ToF’s high accuracy, they have been proven to have exceptionally high purities. It has already been shown that these dendrimers can vastly improve current mass spectrometry calibrants, as they provide all of the same benefits while offering the additional benefits of long shelf-lives and higher solubility and compatibility with MALDI-ToF matrices. Therefore, future goals for this project include continuing to push each core to the fifth generation utilizing the same general synthesis, while also continuing to optimize the procedure to ensure faster generation of the products. Additionally, once these higher generation dendrimers are synthesized, these products will be used to calibrate mass spectrometry techniques for numerous other projects.

References


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