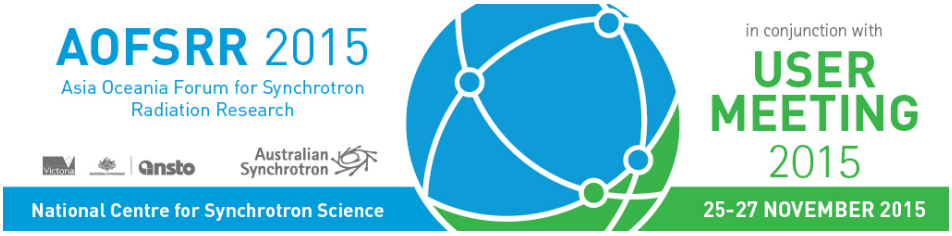

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Applications of Synchrotron FT-IR secondary structure determination using the amide III region to protein based bioplastics

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Bulk proteinaceous feedstocks used for bioplastic production are often insoluble and may already be denatured but retain some secondary structural features. The amide I region is commonly used for secondary structure estimation, but can be subject to interference from processing aids used to convert proteins into thermoplastics. The amide III region is much weaker but also sensitive to secondary structure change.

Synchrotron IR sources give a very good signal to noise ratio at small spatial resolutions enabling analysis of the amide III region. A method of estimating relative changes in secondary structure using the inverted second derivative has been developed to overcome the influence of subjective baseline corrections across the multiple spectra collected in spatial maps or time resolved heating experiments. In the context of dried blood as a proteinaceous feedstock, this method successfully predicts a much higher β-sheet content and reduced α-helical content in blood that has been thermally denatured and aggregated than for lyophilised BSA or spray dried haemoglobin, which retain more of their native structure.

Mapping secondary structure distribution in bioplastics made from these proteins showed significant structural rearrangement after extrusion. Even with plasticisers, conformational change towards increased ordered structure occurred at typical processing temperatures, not just on cooling from the melt. The rapidity with which good quality, high signal-to-noise spectra can be collected, suggests kinetic data could also be obtained.

Keywords

Protein, bioplastic, secondary structure, FT-IR micro spectroscopy, kinetics

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