Investigations of polypeptide topology and rotational diffusion in aligned membranes by ^{2}H and ^{15}N solid-state NMR spectroscopy

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A solid-state NMR approach which allows for the accurate determination of the tilt and rotational pitch angles of peptides reconstituted into uniaxially oriented membranes will be presented. The method works with transmembrane or in-plane oriented peptides that have been labelled with 3,3,3-$^{2}H_3$-alanine and ^{15}N-leucine at two selected sites. Proton-decoupled ^{15}N and ^{2}H solid-state NMR spectroscopy at sample orientations of the membrane normal parallel to the magnetic field direction have been used to characterize the tilt and rotational pitch angle of several peptides in considerable detail.

When the same samples are inserted into the magnetic field at 90 degrees tilted alignments provide valuable information on the rotational diffusion constants in membranes and thereby of the association and size of peptide complexes within the membrane environments. Whereas monomeric transmembrane peptides exhibit spectral averaging and well-defined resonances, larger complexes are characterized by broad spectral line shapes. In particular the deuterium line shape is sensitive to association of a few transmembrane helices. In contrast, the formation of much larger complexes affects the ^{15}N chemical shift spectrum.

The biological systems investigated by us using solid-state NMR spectroscopy include antibiotic peptides, polypeptide channels, signal sequences, DNA transfectants, Alzheimer fibrils, colicins and proteins involved in apaptosis.

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