Peptide fibers: Electrospinning from solutions, molecular vibrational analysis

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Abstract

Besides their wide biochemical relevance, peptides can assemble to defined supramolecular structures such as fibers [1,2] and tubes [3-6]. Of these, amyloid-like fibers are of special medical relevance for deseases such as Alzheimer [1]. While the main driving mechanism is certainly based on electrostatics, the directing role of aromatic groups might be essential. We used short peptides and peptide derivates that contain the aromatic side groups fluorenyl and phenyl. Fibers can be built by growth in solution, or by electrospinning from concentrated solutions [7], which is normally only possible for macromolecules (Fig. 1). The choice of the solvents is here critical; fluorinated alcohols and acids are often required.

We elucidated chemical groups in the fibers by Raman and infrared spectroscopy [8]. The observed spectra compare very well with simulation results of the respective single molecules in vacuum (Fig. 2), with the exception of zwitterions where a dielectric environment was modelled. We were able to assign all observed vibrations. The main differences between solid phases and single molecules are found for O-H and N-H stretching and bending vibrations, due to extensive hydrogen bonding in solids. While the fluorenyl and phenyl residues cause pi-stacking of the molecules, this barely manifests in the spectra, but clearly in the structures.

References

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Figures

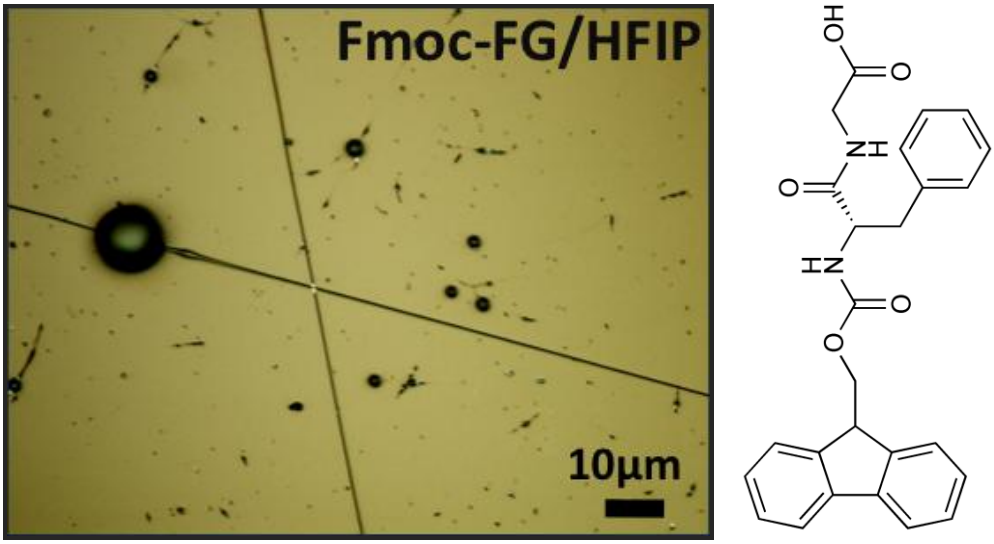

Fig. 1 Optical micrograph of Fmoc-Phe-Gly fiber, electrospun from HFIP (hexafluoroisopropanol). At right: Chemical structure of Fmoc-Phe-Gly.

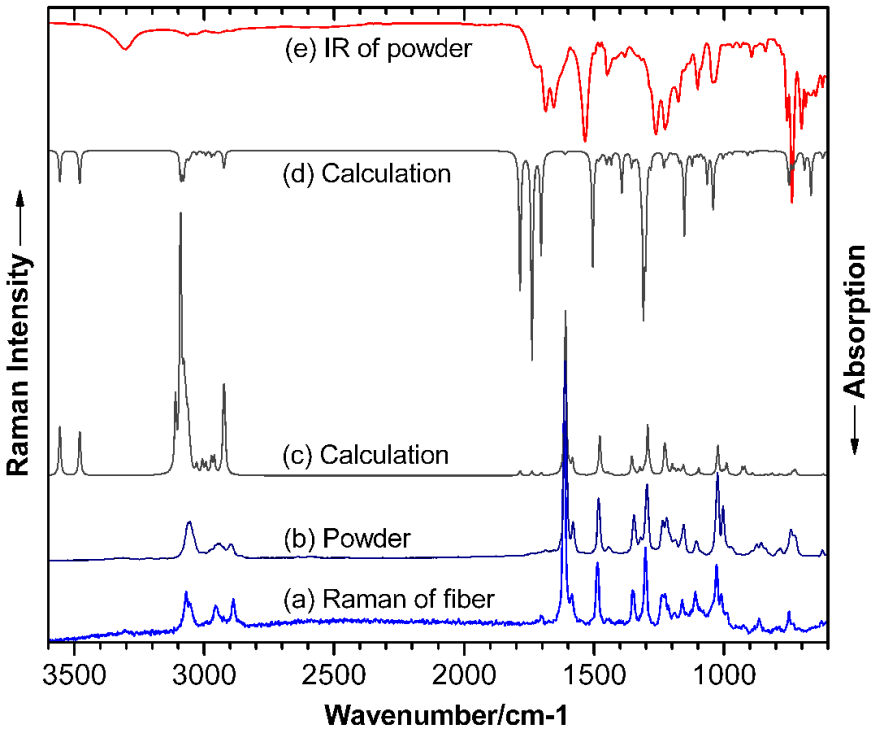

Fig. 2 Vibrational spectra of Fmoc-Phe-Gly