

In situ rheological monitoring of protein amyloid fibrillation: correlating structural assembly and mechanical adhesion

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Résumé :

Proteins are complex natural polymers capable of hierarchical self-assembly, ranging from the molecular level to the formation of amyloid fibers at the microscopic scale, and, at the macroscopic scale, to three-dimensional networks responsible for gelation. These multi-scale architectures confer remarkable mechanical and adhesive properties to proteins, comparable to those of certain natural bioadhesives produced by organisms such as mussels or barnacles, which adhere strongly to marine rocks¹.

We present a methodology using a rheometer to induce and monitor in situ the fibrillation and gelation of proteins under the combined effects of temperature and shear, followed by a tensile test to quantify their adhesive properties. This method, adaptable to different types of proteins, allows the same geometry to be maintained for both gelation and adhesion testing, thus preserving the formed fibrillar structure, while using small sample volumes, which is often required for studying biological systems. Two model proteins were investigated: bovine serum albumin (BSA) and lysozyme, which exhibit different fibrillation/gelation conditions. Our results show that, despite these differences, the same methodology can be applied to establish a clear correlation between structure (amyloid fibers), mechanical properties (gelation) and adhesion.

This approach paves the way for a better understanding of structure-property relationships in complex biological polymers such as proteins and could contribute to the development of new bioinspired adhesives and materials.

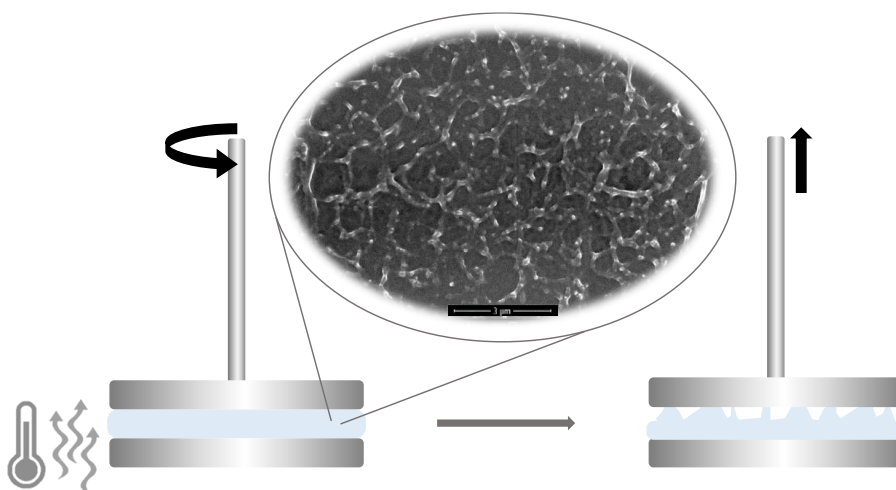


Figure. Schematic representation of in situ rheological induction of BSA fibrillation, with a SEM image of the fibrils, followed by a tensile test to assess adhesion properties.

Références :

[1] : K. Fears ; B. Orihuela ; D. Rittschof ; K. Wahl, *Advanced Science*, 2018, **5**, 1700762