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FROM DYNAMIC STRUCTURES TO FUNCTIONAL MATERIALS

Deposition of neuro-supportive self-assembling peptides by zone casting for bio-electronic applications

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The self-assembly of peptides, although an ancient and naturally occurring process in biological systems, has only been explored by materials science over the past few decades. Peptides typically undergo self-assembly into stable β-sheet secondary structures, forming amyloid-like architectures that are observed microscopically and macroscopically as fibrillar networks. The combination of the inherent biocompatibility and low toxicity of peptides[1], arising from their chemical structure, with their ability to form fibrous assemblies upon self-assembly provides a promising platform for the fabrication of novel biomaterials. Such materials are particularly attractive for biological applications, including cell culture, where electrically responsive cells, such as neurons, could be cultured in an organized manner with properties desirable for bioelectronic devices.

Several factors promote fibril formation and stabilize the peptide secondary structure, including pH, temperature, peptide concentration, ionic strength, and amino acid sequence. These parameters influence intermolecular interactions such as hydrogen bonding, electrostatic interactions, and π–π stacking[2]. From a materials science perspective, many of these parameters can be precisely controlled during thin-film fabrication. For example, temperature can be readily adjusted in zone-casting, a meniscus-guided coating (MGC) technique capable of producing highly homogeneous polycrystalline thin films. Likewise, peptide concentration, pH, and chemical structure can be systematically tailored to complement the processing conditions during zone casting, thereby recreating the physicochemical environment required to induce peptide self-assembly.

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2. Kaygisiz, K. Ender, A. Gačanin, J. Kaczmarek, L. Koutsouras, D. Nalakath, A. Winterwerber, P. Mayer, F. Räder, H. Marszalek, T. Blom, P.W.M. Synatschke, C.V. Weil, T. Photoinduced Amyloid Fibril Degradation for Controlled Cell Patterning. *Biosci*. 2200294, **1-9** (2023).