PROBING SUB-MICRON FIBROUS ANISOTROPY USING QUANTUM DOTS AND SINGLE-PARTICLE DIFFUSOMETRY

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SUB-MICRON ANISOTROPY

Quantification of sub-micron anisotropy present in fibrous, anisotropic food structures is required to understand the impact of the formation and degradation of food products. However, non-invasive techniques for assessing sub-micron structural anisotropy without severe sample pre-treatment are currently not available. We will use single-particle diffusometry as a means to spatially quantify the structure of fibrous food products with sub-micron resolution.

SIZE-DEPENDANT DIFFUSOMETRY

κ-carrageenan gels are used as a model system for fibrous food structures, as it is a mostly-transparent system with easily adjustable parameters such as fibre density and heterogeneity. Single-particle tracking is achieved by adding quantum dots to the system, as they can be synthesized with a broad range of sizes (up to one order of magnitude difference). The variation in size leads to different diffusion properties caused by the fibrous structure (see Figure 1 Top). Larger fluorescent probes are expected to be slowed down by anisotropic structures more rapidly in comparison to smaller probes[1].

This system is imaged by a home-built super-resolution TIRF microscopy framework with a very small footprint (see Figure 1 Bottom). This system excels both in spatial resolution – it is able to provide a resolution of ±30 nm in a 130x130 µm field-of-view – and in temporal resolution – full-frame images can be recorded with a speed up to 200 Hz, with higher speeds possible alongside a smaller field-of-view.

By tracking localized particles the diffusion constant can be calculated in a spatial manner. The localized diffusion constants can be mapped, showing the heterogeneity of the structure. Moreover, this diffusion behaviour can be modelled to the fibrous structure of the sample[2]. Thus, this system is capable of providing spatial information on the structure of fibrous networks with large field of views and high precision.

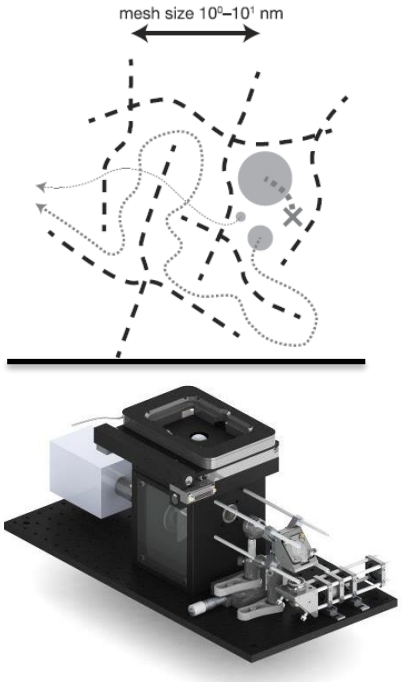

Figure 1: Top: Probing different structural sizes by using differently-sized quantum dots[1].
Bottom: Home-build super-resolution TIRF microscopy setup

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