A soft matter science approach to eye lens diseases

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We increasingly see attempts to use the experimental and theoretical toolbox of soft matter and materials science to understand complex biological systems. I will highlight this approach with the example of the mammalian eye lens, and show that soft matter physics may indeed provide key insight into important eye lens diseases such as cataract. The mammalian eye lens basically consists of a highly concentrated protein solution designed to provide a high index of refraction, while at the same time remaining almost completely transparent. In our work we investigate the structure and dynamics of concentrated lens protein solutions and mixtures at the relevant length and time scales using a combination of scattering and simulation techniques. We then try to exploit direct analogies between colloids and globular proteins to better understand a number of physiologically highly relevant phenomena. Such an approach helps us for example to shed light on the important question of why the eye lens is usually transparent and what goes wrong when this transparency gets lost and a cataract starts to develop. In addition to the structural properties, our attention has recently also turned to the dynamic properties of these lens proteins under crowded conditions, as they can be found in the eye lens, and their link to possible arrest transitions within the eye lens that may be related to the phenomenon of age-related presbyopia.