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Self-assembly of graded refractive index in squids: a patchy colloid explanation JING CAI, PAUL HEINEY, ALISON SWEENEY, Univ of Pennsylvania — Squids have a spherical eye lens that achieves both acute and highly sensitive vision underwater. The spherical shape necessitates a graded refractive index (GRIN) to form sharp images. This index variation comes from a gradient in protein packing fraction ranging from approximately 0.05 to 1.0. This presents a materials conundrum: optical transparency requires that the protein density fluctuation at length scales > 100 nm is minimized throughout the lens, something that is difficult to achieve with simple spherical particles. Here we show that squids have accomplished this by evolving a suite of proteins that can act as patchy colloids with specific low valence (M=2 or M=3). We conducted small x-ray scattering (SAXS) at different radial positions of the lens, and performed a Monte Carlo simulation to estimate structures consistent with the SAXS result. This analysis suggests that lens proteins may form a density gradient gel structure, with density mediated by a tightly controlled protein coordination number in each region. Patchy colloid theory may therefore explain both the GRIN and the transparency evolved in the lens.

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