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Structure of biological graded refractive index materials, and possible routes to self-assembly JING CAI, PAUL HEINEY, ALISON SWEENEY, Univ of Pennsylvania — For a camera-like eye, a spherical lens with a radially graded refractive index is required for high-quality image formation. Squids have evolved this lens design, and the index gradient results from variation in the density of protein in the lens from the center (70% packing fraction) to the periphery (2% packing fraction). However, density fluctuations must also remain low in all regions to maintain lens transparency. Squids have achieved this by an evolutionary radiation of the isoforms of one protein, S-crystallin; different protein isoforms are synthesized in different radial positions of the lens. We studied whether these proteins self-assemble into the observed gradient index material. X-ray scattering was performed on both intact lenses and solubilized lens protein. Our results show that protein packing is organized, and that the organization changes with radial position. We identify possible self-assembled routes to the observed structures via the predicted interactions between the proteins. Our study may provide insights into engineering new self-assembling graded refractive index materials.

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