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Self-assembled structural color in nature[1]

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The vibrancy and variety of structural color found in nature has long been well-known; what has only recently been discovered is the sophistication of the physics that underlies these effects. In the talk I will discuss some of our recent studies of the structures responsible for color in bird feathers and beetle elytra, based on structural characterization using small angle x-ray scattering, x-ray tomography and optical modeling. These have enabled us to study a large number of structural color exhibiting materials and look for trends in the structures nature uses to provide these optical effects. In terms of creating the optical structure responsible for the color of the Eurasian Jay feathers (Garrulus glandarius) the nanostructure is produced by a phase-separation process that is arrested at a late stage; mastery of the color is achieved by control over the duration of this phase-separation process. Our analysis shows that nanostructure in single bird feather barbs can be varied continuously by controlling the time the keratin network is allowed to phase separate before mobility in the system is arrested. Dynamic scaling analysis of the single barb scattering data implies that the phase separation arrest mechanism is rapid and also distinct from the spinodal phase separation mechanism i.e. it is not gelation or intermolecular re-association. Any growing lengthscale using this spinodal phase separation approach must first traverse the UV and blue wavelength regions, growing the structure by coarsening, resulting in a broad distribution of domain sizes.

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