Flash posters session, Wednesday 9 September 12:35– 13:00 / Poster sessions P.02

(FP1) Spatially modulated structural colour in bird feathers

A J Parnell[1], A L Washington[1], O O Mykhaylyk[1], C J Hill[1], A Bianco[1], S L Burg[1], A J C Dennison[2,3], M Snape[1], A J Cadby[1], A Smith[4], S Prevost[5], D M Whittaker[1], R A L Jones[1], A R Parker[6] and J P A Fairclough[1]

[1]University of Sheffield, UK, [2]University Grenoble-Alpes, France, [3]Institut Laue-Langevin, France, [4]Beamline I22 Diamond Light Source, UK, [5]ID02 Beamline, European Synchrotron Radiation Facility (ESRF), France, [6]Natural History Museum, UK

Eurasian Jay (*Garrulus glandarius*) feathers display periodic variations in the reflected color from white through light blue to dark blue and black [1]. We find the structures responsible for the color are continuous in their size and spatially controlled by the degree of spinodal phase separation [2] in the corresponding region of the feather barb. Blue structures [3] have a well-defined broadband ultra-violet (UV) to blue wavelength distribution; the corresponding nanostructure has a characteristic spinodal morphology with a lengthscale of order 150 nm. White regions have a larger 200 nm nanostructure, consistent with a spinodal process that has coarsened further, yielding a much broader wavelength white reflectance. Our analysis shows that nanostructure in single bird feathers barbs can be varied continuously by controlling the time for which the keratin network is allowed to phase separate before the 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. Making it impossible to produce the narrow domain size essential for a non-iridescent structural green, finally answering the longstanding conundrum of why green, an obvious camouflage color is not prevalent in the natural world as solely a structural color.

[1] Osorio, D. & Ham, A. D. Spectral reflectance and directional properties of structural coloration in bird plumage. *Journal of Experimental Zoology* 205, 2017–2027 (2002)
[2] Jones, R. A. L. *Soft Condensed Matter*. (Oxford Univ. Press, 2002)
[3] Dufresne, E. R. *et al.* Self-assembly of amorphous biophotonic nanostructures by phase separation. *Soft Matter* 5, 1792–1795 (2009)