Physical Mechanism of Iridescent Color in Peacock Feathers

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The iridescent color of peacock (*Pavo cristatus*) feathers is one of the most famous examples of the structural color in nature. It is also widely known that the optical interference phenomenon is closely related to the iridescent color. In 1960s, the electron microscopic study has been reported that there exists the periodic structure of melanin spheres, which is responsible for the optical interference.[1]

We have investigated in detail the physical mechanism of the iridescent color by the measurement of the angle dependence of the reflection spectra and the observation of the microscopic structure by the use of a scanning electron microscope (SEM). Figure 1 (a) shows the angle dependence of the reflection spectra under the normal incidence. As the view angle increased, the peak position shifts to shorter wavelength. That is consistent with a visual observation by human eyes: the color changes from yellow into green. The SEM image of a cross section of a barbule is shown in Fig. 2. The periodic array of small spheres with the diameter of 140nm is clearly observed, which agrees with the early observation.

We have simulated the reflection spectra shown in Fig.1 (b) by proposing the model, which consists of an array of spheres. The simulation reproduces the experimental results fairly well. From the simulation using the model, it has been found that the iridescent color of peacock feathers is produced by the cooperative work of the several elements: (1) Mie scattering from each sphere, (2) the optical interference of the scattered light, (3) the incomplete periodicity of the array, (4) The light absorption caused by melanin pigment.

[1] H. Durrer: Verhandl. Naturf. Ges. Basel **73** (1962) 204.

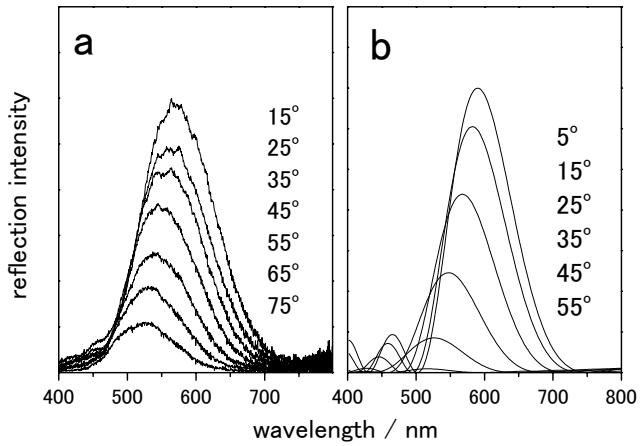

Fig.1 a) Experimental and b) simulated angular dependence of the reflection spectra from several barbules of a peacock feather.

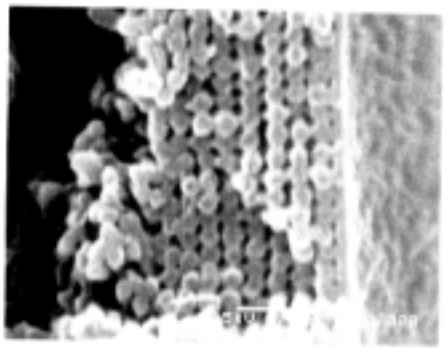

Fig.2 The SEM image of a cross section of a barbule of a peacock feather. (x 50000)