

The origin of the color of pearls in iridescence from nano-composite structures of the nacre

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ABSTRACT

The origin of the variety of body colors exhibited by South Sea Pearls is in part due to a newly recognized structure of the nacre, the edge-band structure, which gives rise to interference colors characteristic of its width. With the pearl oyster, *Pinctada maxima*, the colors include a range of silver tones, creams, yellows, and gold in various degrees of color saturation. We establish here that the primary body color of *P. maxima* pearls arises from the interference of light within the binding regions of the aragonite tiles. The tile faces terminate in a fissured nano-composite structure containing organic matrix within the margin of the aragonite tiles. This edge-band structure gives rise to an optical film formed of organic matrix in aragonite. The TEM images show that the edge-band structure width increases progressively from 74(4) nm in a silver pearl, to 80(4) nm in a cream pearl, and to 90(4) nm in a gold pearl. These colors are the first-order Newton's colors, which, when mixed with the specular reflection of the nacre and modified by any pigmentation present, give rise to the body color of pearls. The non-metallic whiter pearls more commonly seen can be accounted for by disorder of this structure leading to unsaturation of the color.