On The Nature Of Iridescent Patterns Of Some Molluscan Shells

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Abstract: The present work is concerned with the iridescent patterns of some specimens of molluscan shells and their intensity distribution patterns worked out with the help of software. The iridescence colours of shells have been ascribed to diffraction and their laminated structures. In this case earlier observations by Sir C. V. Raman in connection with the iridescent patterns have been critically analysed.

Keywords: Iridescent patterns, Molluscan shells.

1. Introduction:

Molluscan shells have attracted the attention of researchers for many interesting physical phenomena exhibited by these objects. The materials of the molluscan shells present different appearances in different cases. The shell of a molluscan built out of calcium carbonate has 3000 times higher fracture resistance than crystals of calcium carbonate. Several decades ago Raman and his coworkers[1-5] investigated experimentally various optical properties including iridescent patterns. Recently Konwar[6] and Konwar et. al[7] have investigated the laser induced fluorescence and other spectroscopic properties of few molluscan shells. It is worthwhile to note here that in spite of the extensive work done during several decades on various aspects of molluscan shells, the emergence of the field of nanoscience has greatly influenced the field of bio-mineralization. In the present work we primarily concerned with the iridescence colours of some Molluscan shells, and their analysis with the help of software known as Image J which is primarily used for the measurement of intensity.

2. Iridescence colours:- What they are?

The iridescence patterns of the molluscan shell are the coloured patterns which are usually seen under normal condition of illumination in some molluscan shells. The iridescence colours of shells have been ascribed to either interference or diffraction, while the diffraction component is well established to account for the multicoloured iridescent colour component in shells; the origin of changes in body colour in the case of pearl has not been clearly established. Lord Rayleigh[8] was also interested in iridescent colour and the physics behind the process of iridescence, and one of his papers is devoted to iridescent beetles. Similarly as early as in 1923 Ramdas[9] had investigated feeble iridescence from potassium chlorate crystal. Potassium chlorate belongs to the monoclinic class of crystal, and its natural occurrence takes the form of flat plates containing many twins, when a crystal plate is held so as to reflect light obliquely and is turned around in its own plane, colours alternately appear and disappear twice in each complete revolution. The spectral character of the reflected light also varies with the angle of incidence. In a recent work[10] the author has described how butterfly wings involve nano system particularly the photonic band.

3. Iridescent patterns of Molluscan shells and 3D intensity distribution patterns:

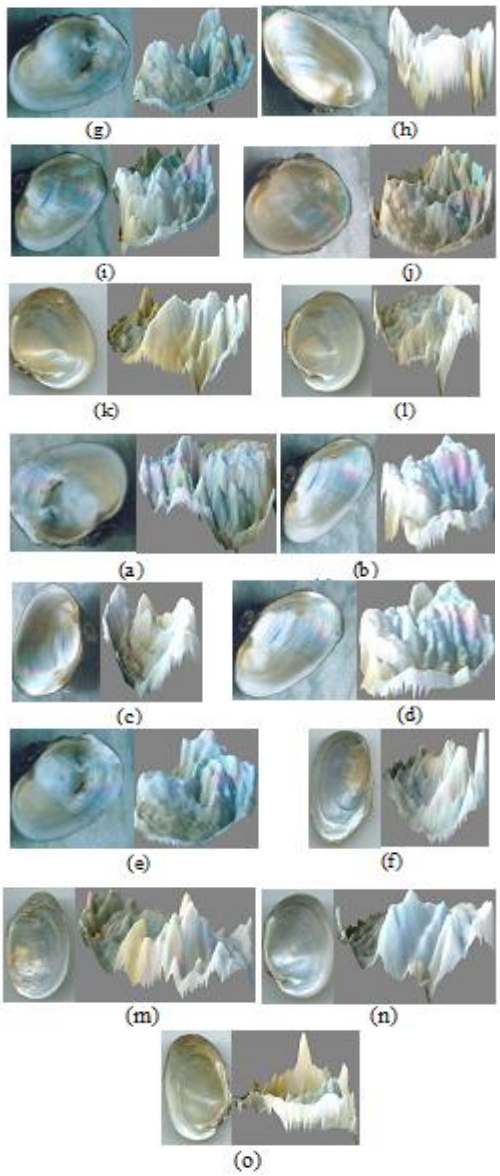

Fig:1 *Iridescence pattern of molluscan shells and their three dimensional intensity distribution patterns.*

Fig:1(a,b,c,… ……,o) shows the surfaces of molluscan shells under illumination by a broad band light of a scanner connected to a computer. We have used software (Image-J) to work out the three dimensional intensity distribution patterns of the iridescent molluscan shells. It may be noted that the colours exhibited by these photographs are actually the manifestations of the optical properties associated with the relative thickness of the conchin and aragonite layers in different specimens of shells. A close examination of the intensity distribution pattern show several sharp peaks on the background and these are actually conchin layers intersected with the surface of the shell and their configuration depends upon the curvature of the intersecting surfaces and the angle at which they meet. We thus find that the method of three-dimensional intensity patterns gives qualitative information about the nature of iridescent patterns. In this connection we would like to indicate the nature of the laser induced fluorescence (LIF) of some specimens of molluscan shells which have been earlier investigated by us[6]. The salient features of the LIF spectra are shown in Table:1.

Table: 1 *Laser induced fluorescence band systems of ten different samples of Molluscan Shells.*

Sample no.	Range of wavelength (Å)	Intensity	Wavelengths of the persistent pair	Intensity	Iridescence observed
a	5900-6650	s	5372.8, 5407.1	w	YES
b	5850-6600	s	5372.8, 5407.1	w	YES
c	5800-6300	vs	5372.8, 5407.1	vs	YES
d	~	vw	5372.8, 5407.1	vs	YES
e	5800-6700	s	5372.8, 5407.1	w	NO
f	5850-6700	vs	5372.8, 5407.1	s	YES
g	5850-6700	vs	5372.8, 5407.1	vw	NO
h	5800-6900	vvs	5372.8, 5407.1	vvs	YES
i	5800-6900	vvs	5372.8, 5407.1	vw	NO
j	~	vw	5372.8, 5407.1	w	NO

vvs = very very strong, vs = very strong, w = weak and vw = very weak.

We have noted earlier in the case of LIF of molluscan shells, that the molluscan shells exhibit strong fluorescence in the yellow – red region with a pair of weak band heads also appearing with moderate intensity. They have been identified with the persistent lines belonging to the First Positive band system of N_2 molecule. It is worthwhile to note as shown in Table:1, iridescent patterns do not appear in case of shells which do not exhibit fluorescence or exhibit fluorescence with extremely weak intensity.

4. Conclusion:

From what has been discussed above it is appropriate to make a conclusion regarding the iridescent patterns of molluscan shells. The iridescent patterns of the shells depend on their laminated structures.

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