

Metallic sheen without metals and colours without dyes:

Towards a new, sustainable way of resource management via nanostructural colours

By Razman A., Diah S.Z.M., Karman S., Zobl S. and Gebeshuber I.C.

Universiti Kebangsaan Malaysia, Universiti Malaysia, Academy of Fine Arts Vienna & Vienna University of Technology, Austria

In conjunction with :



NANOPOSTER 2013
3rd Virtual Nanotechnology
Poster Conference

Abstract :

Mankind has been utilizing nanostructures to generate colours for many years. One great example is the colourful stained glass of medieval churches. Even longer, plants, animals and microorganisms have been utilizing nanostructures in creating colours – some fossils of beetles still shine with all the colours of the rainbow, as they did when they were alive. The poster will demonstrate basic physical principles of colours generated by nanostructures exemplified by soap bubbles and colourful biological nanostructures from butterflies beetle wings and Malaysian plants.

Observation :

Have you ever wonder why the soap or shampoo in the bottle are single coloured, but when you make a bubble, you will see a wide spectrum of colour? Well, that is because the change of structure have made that happen. It is also the reason why CD have rainbow like colours as well, the grating of the binary information 0 and 1 gives the structure for the colour to be generated.

The common sight of soap bubbles that displays structure colours

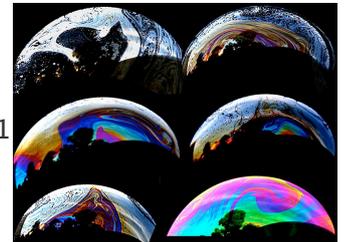


Fig 1. (right) Ref.1 :

Even more embarrassing, evolution have beat us into utilizing nanostructure long long before man ever taped into it. Common examples of this are some butterfly wings and iridescent plants.

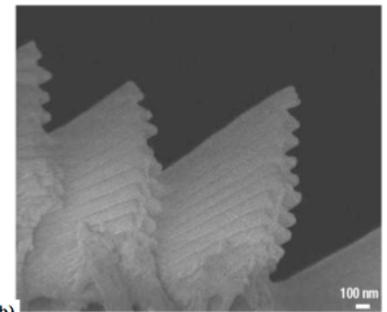


Fig 2. (Top) Ref.2 : Peacock Fern (*Selaginella uncinata*) displaying natural iridescence.

Fig 3. (a) (Bottom) Ref. 3 : Blue iridescent colour reflected from the wings of *Morpho* butterflies



(a)



(b)

Fig 3. (b) (Top Right) Ref. 3 : SEM images show "Christmas tree" PhC profiles with a multilayer combination of cuticle and air.

Our Goal :

We are aiming to abolish the use of pigments in making colours, which by far the most common way of generating colours today. For now, by taking nature as our inspiration, we are making nanostructures as our new method of colouring materials. A very simple example... imagine a black car parked under the sun, due to its pigments, the car will get very hot quickly as a result from absorption, However, if we use nanostructure to colour our car, there are no pigments that acts as catalyst of absorptions, hence the car will stay cool longer (This is of course only an idea for now).

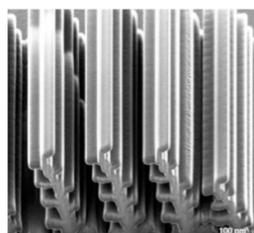


Fig 4. (b) (Left) Ref. 3 : A mimic of the blue Morpho Butterfly wings fabricated with the FIB-CVD method

Other Practical Uses :

As nanostructures generate colours, we can use it as a new "paint" for making pictures and art. The benefit of this is that the colours will not fade away as how pigments does. As long as the nanostructures are intact, there will still be colours generated. For example, as long as a CD are not damaged or scratched, the "rainbow-like" colours on it will be there forever.

References :

- [1] Image courtesy of Wikipedia, obtained from http://commons.wikimedia.org/wiki/File:Soap_bubbles_2.jpg
- [2] Gebeshuber, I. C. 2012 "Learning from nature for engineering: How structural colours and other secrets of life around us can help change our technology towards sustainability", Universiti Kebangsaan Malaysia, Image used is from Mr. Foozi Saad, IPGM Malaysia, with permission.
- [3] Tina R. Matin, P. Sushitha Menon, Sahbudin Shaari, and Ille C. Gebeshuber, 2010. Photonic crystal micro and nanostructures in iridescent butterfly wings. Institute of Microengineering and Nanoelectronics, Universiti Kebangsaan Malaysia, Malaysia.