

SUPPLEMENTARY INFORMATION

S1. Algorithm in obtaining the transmission spectrum of a single cover scale.

Suppose transmission of the substrate and the dorsal scales together is α ; transmission of the substrate which is obtained by removing both the dorsal scales and the ventral scales is β ;

Then, transmission of the dorsal scales alone is $\gamma = \alpha/\beta$.

Considering the overlapped areas for adjacent scales, the overlap integer equals to the ratio of the overlapped area to the surface area of the sample, and here it is 0.5 by estimating and calculating the areas in the optical microscopic image (Fig1b).

Then, the average true transmission for a single scale is $\theta = [(1+8*\gamma)^{1/2} - 1]/2$.

S2. Construction method of the simple slab model

Suppose parameters in the model are as follows:

volume of the materials in the upper layer is a with an extinction coefficient of 0.7;

volume of materials in the bottom layer is b with an extinction coefficient of 0.1;

bottom area of the model is c ;

then the simple slab model should be :

bottom area = c ;

considering the influence of extinction coefficient on the optical path length,

thickness of the slab = $[(a*0.7+b*0.1)/0.7]/c$