

A close-up photograph of a metallic structure, possibly a building facade or a large sculpture, featuring sharp, angular edges. The surface is highly reflective, showing bright orange and yellow highlights against a pale, overcast sky. The perspective is from a low angle, looking up at the structure.

L'or orangé

Réflexions sur les reflets métalliques

Mathieu Hébert

# Le reflet métallique

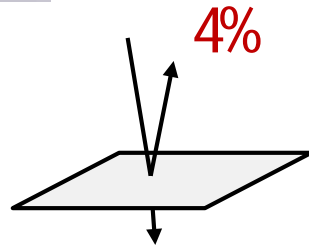
Le métal, un matériau absorbant fortement la lumière,  
... et donc très réfléchissant

Pour comparaison:



verre

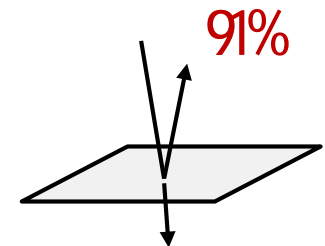
Indice optique:  
1.5



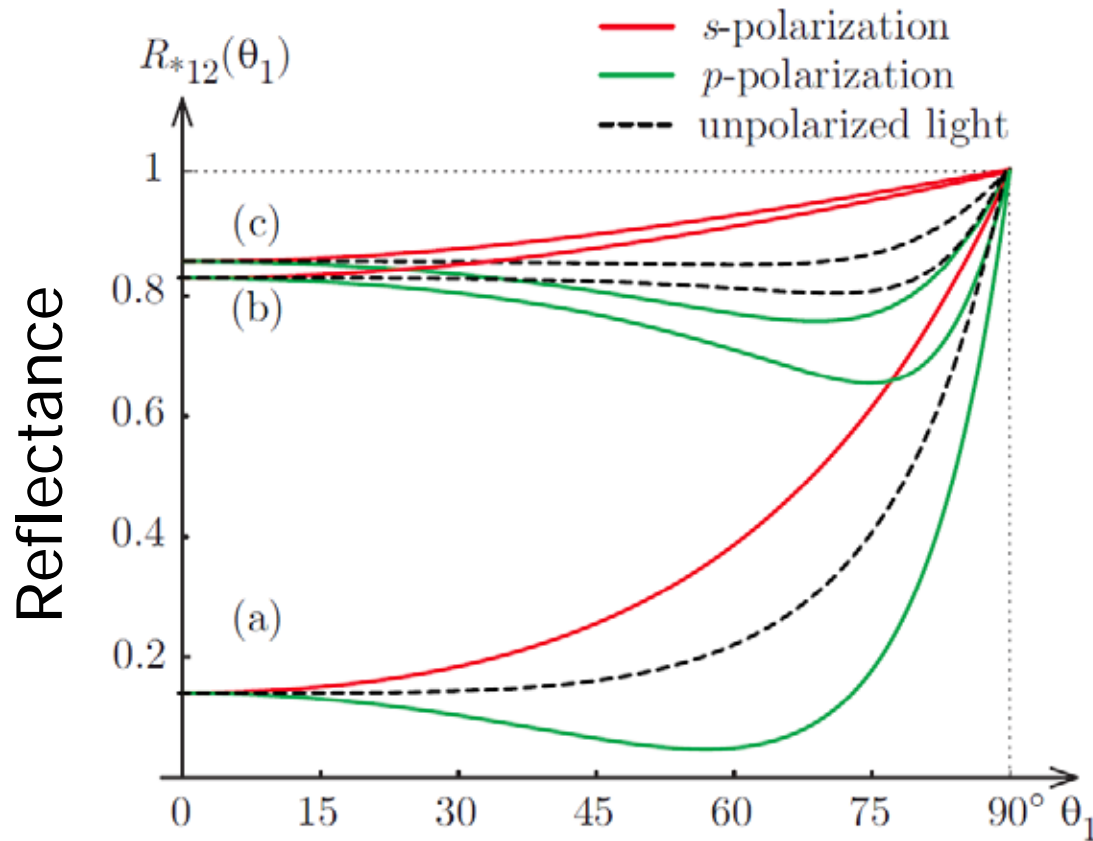
métal

Indice optique (550 nm):  
 $1.01396 + i 6.62878$

↑  
Absorption



Le reflet est prédit par les formules de Fresnel (XIXs) en fonction de l'orientation et de la polarisation du faisceau

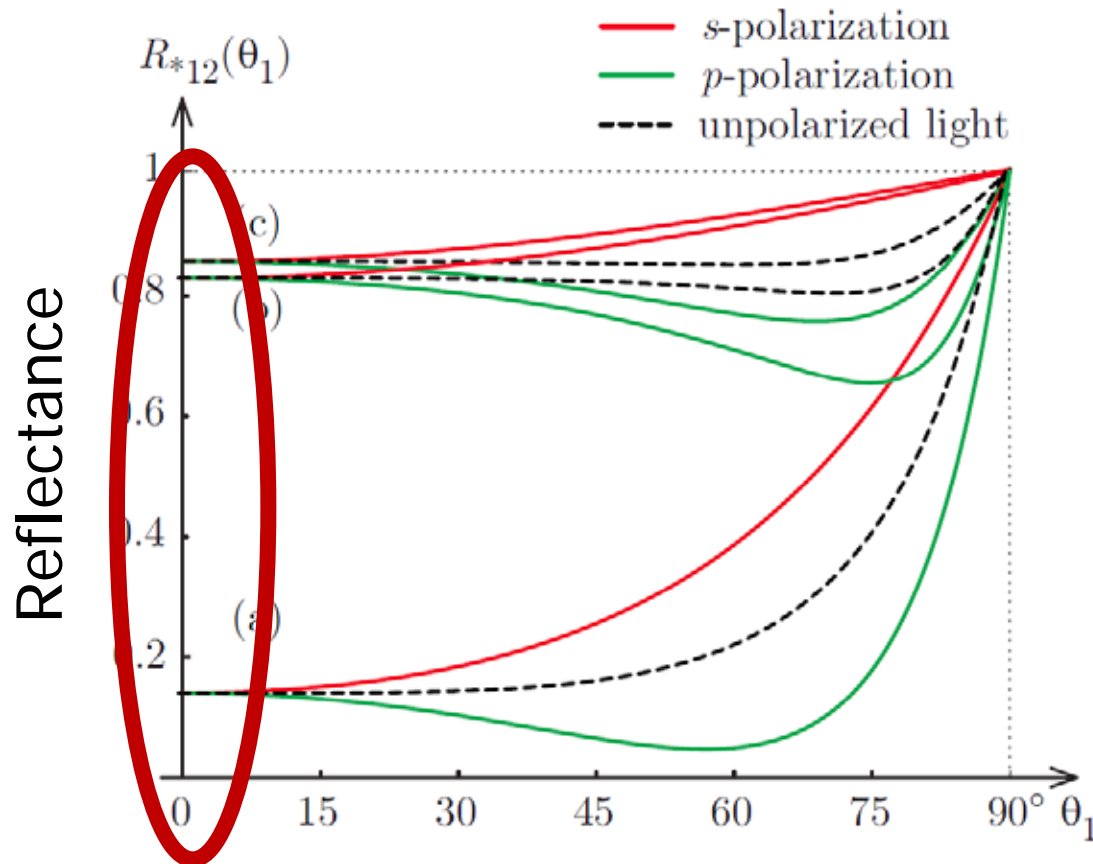


a) Verre très absorbant  
 $\hat{n} = 1.5 + i$

b) Platine à 600 nm  
 $\hat{n} = 2.06 + 4.26i$

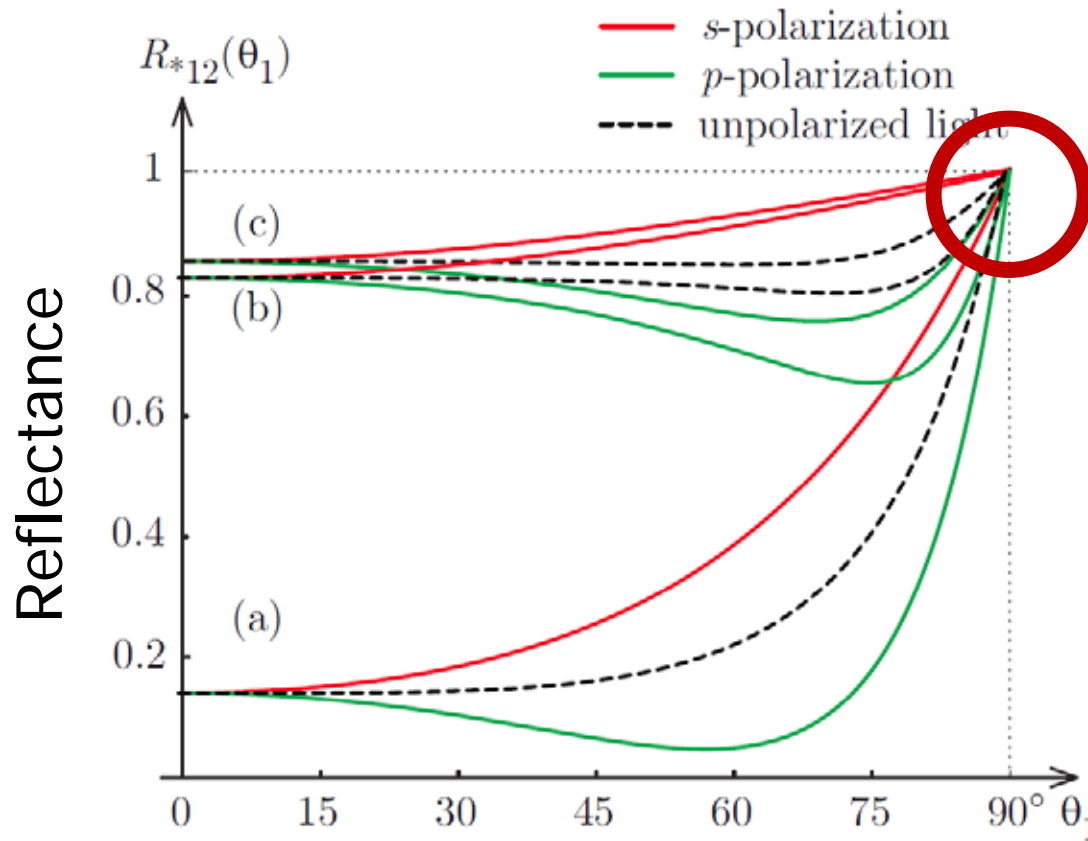
c) Or à 600 nm  
 $\hat{n} = 0.37 + 2.82i$

Le reflet est prédit par les formules de Fresnel (XIXs) en fonction de l'orientation et de la polarisation du faisceau



Incidence normale

Le reflet est prédit par les formules de Fresnel (XIXs) en fonction de l'orientation et de la polarisation du faisceau



Incidence rasante

Réflexion total à observation rasante



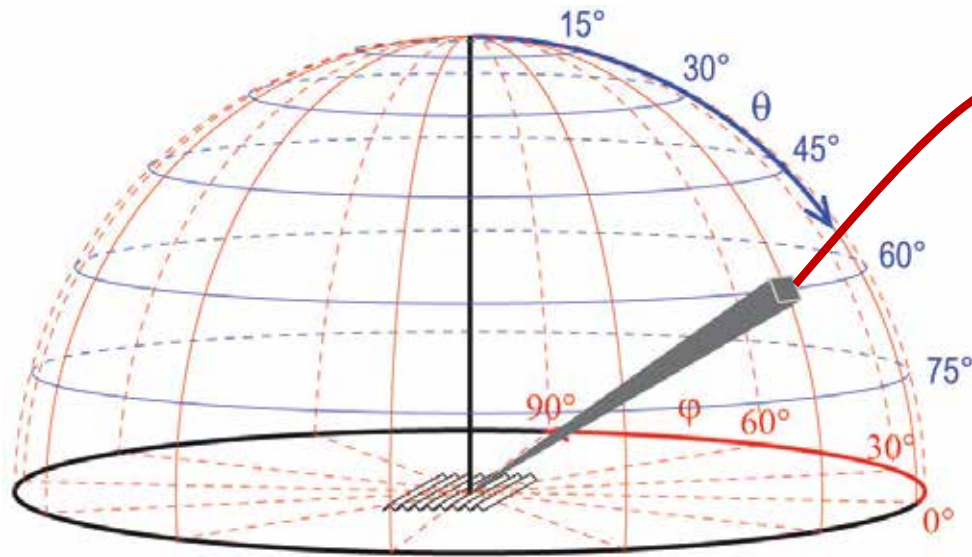
# Le reflet métallique : coloré ?





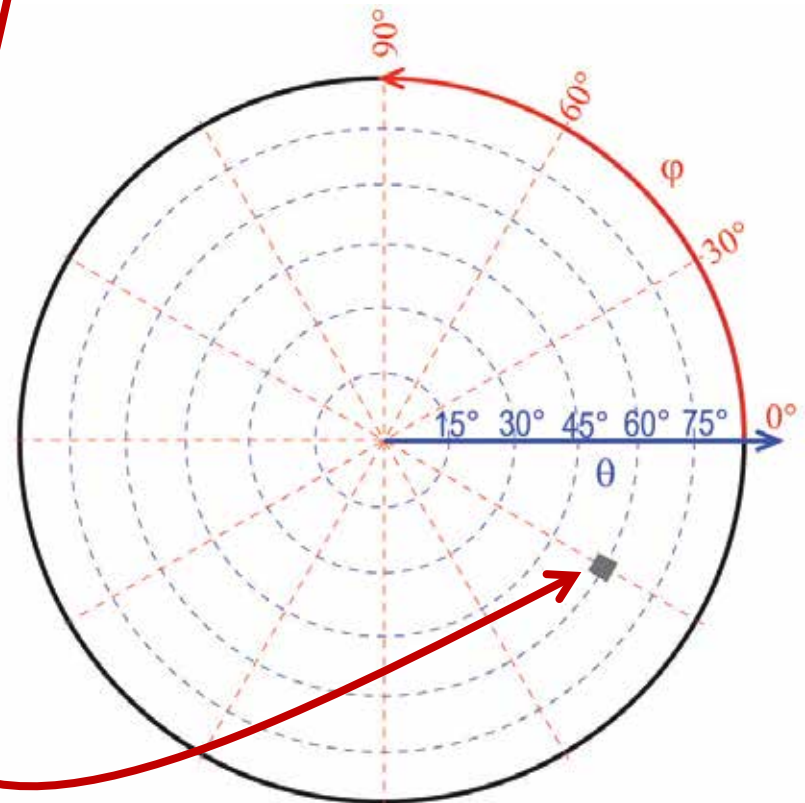




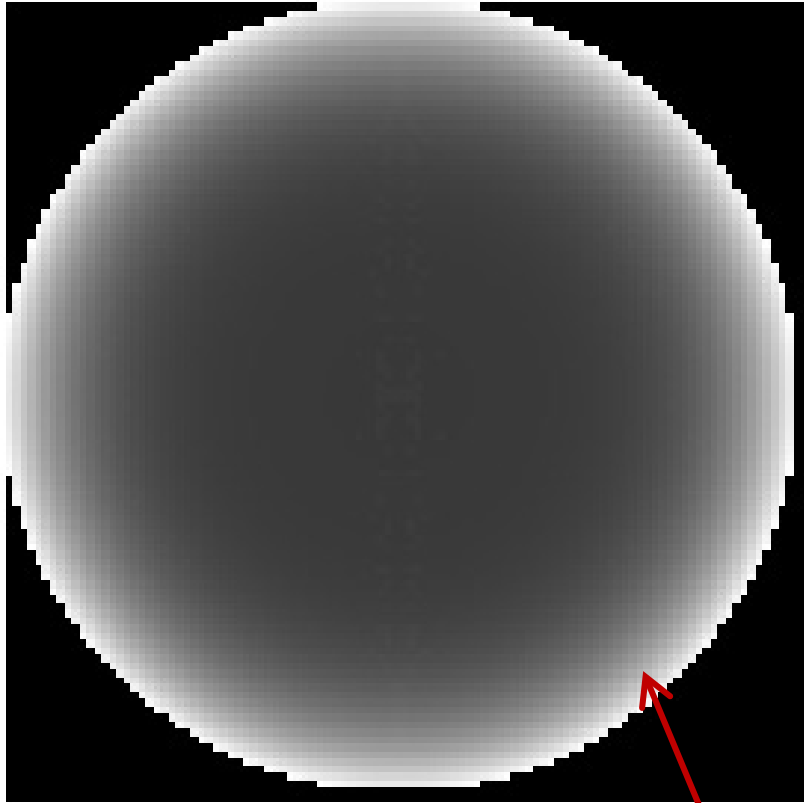


Reflectance spectrale  
convertie en couleur

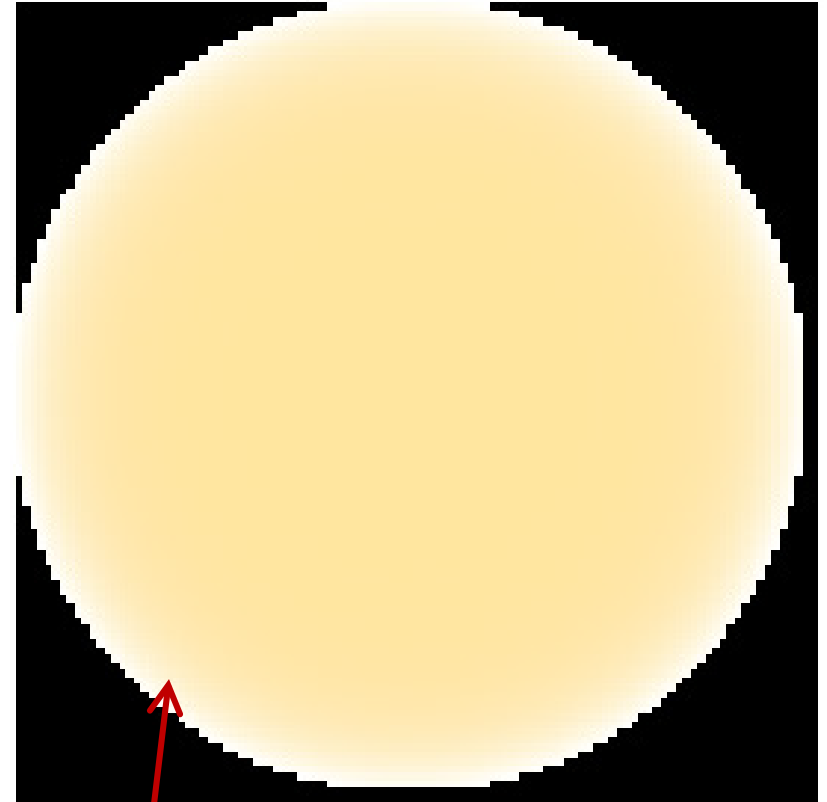
Projection azimutale équivalente  
de Lambert



*Le verre*

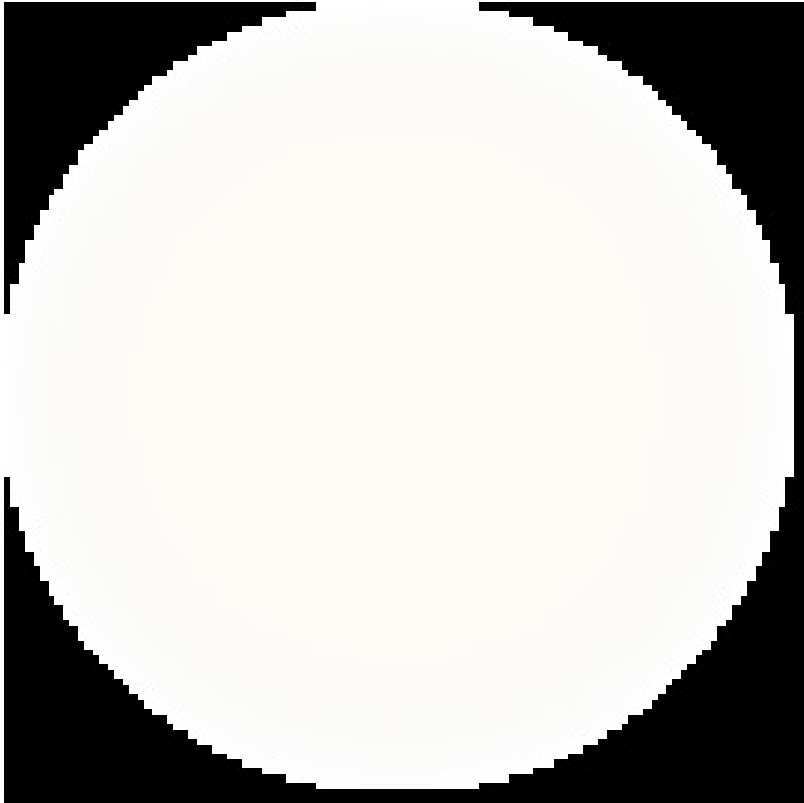


L'or

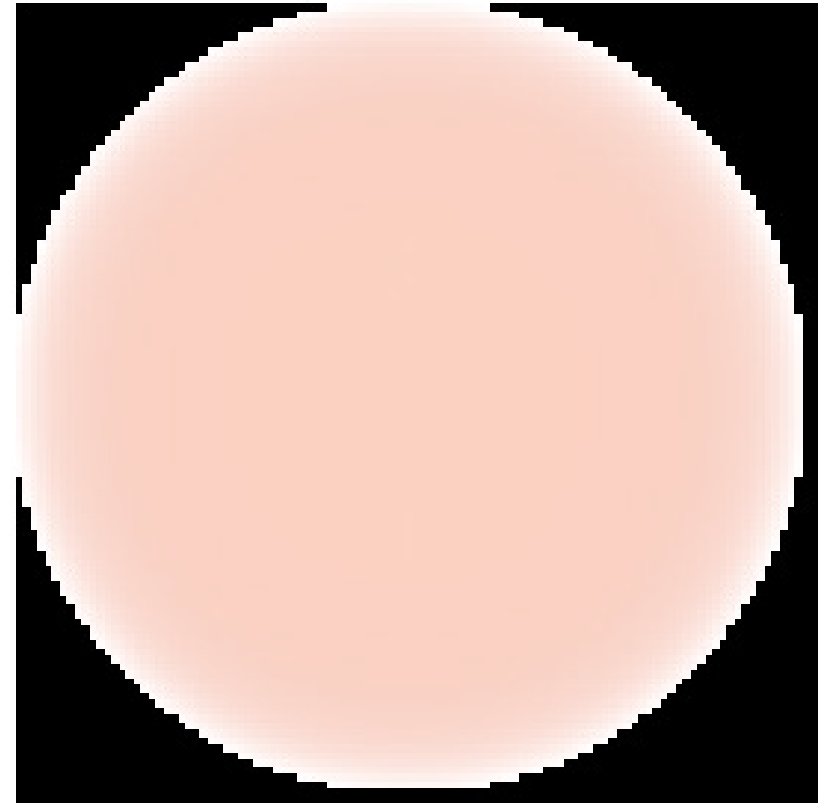


Toute la lumière est réfléchi à incidence rasante

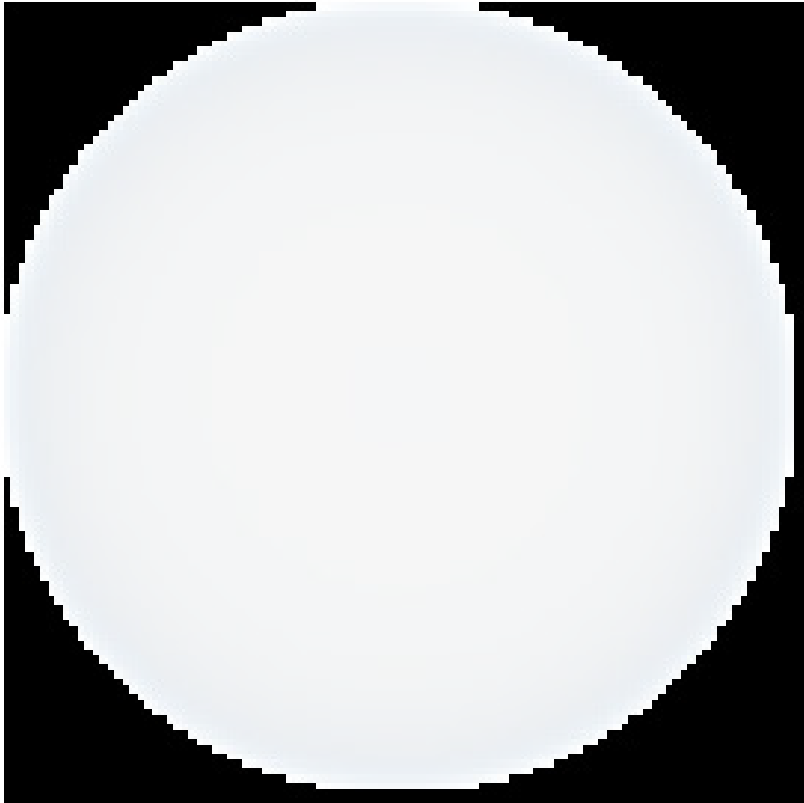
L'argent



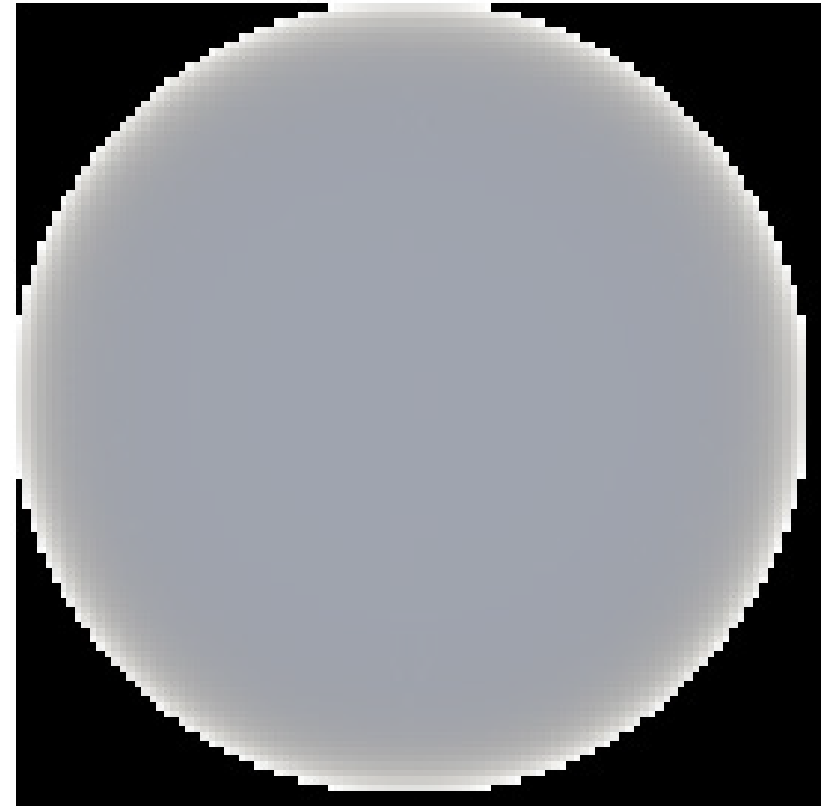
Le cuivre



L'aluminium



*Le Silicium*



# Le reflet métallique : coloré ?

Tableau des éléments de Callet (Mendeleev)  
D'après ISBN 2084352-087-8

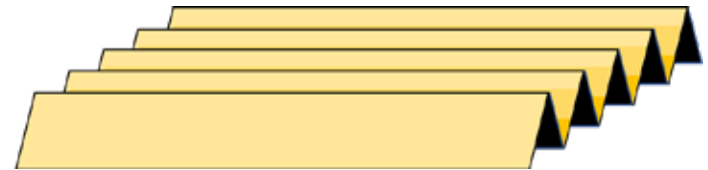
1											
2											
3			Al 13	Si 14							
4				Ti 22	V 23	Cr 24	Mn 25		Fe 26	Co 27	Ni 28
	Cu 29	Zn 30		Ge 32							
5				Zr 40	Nb 41	Mo 42			Ru 44	Rh 45	Pd 46
	Ag 47										
6				Hf 72	Ta 73	W 74	Re 75		Os 76	Ir 77	Pt 78
	Au 79	Hg 80									



Plusieurs réflexions successives se produisent dans des cavités



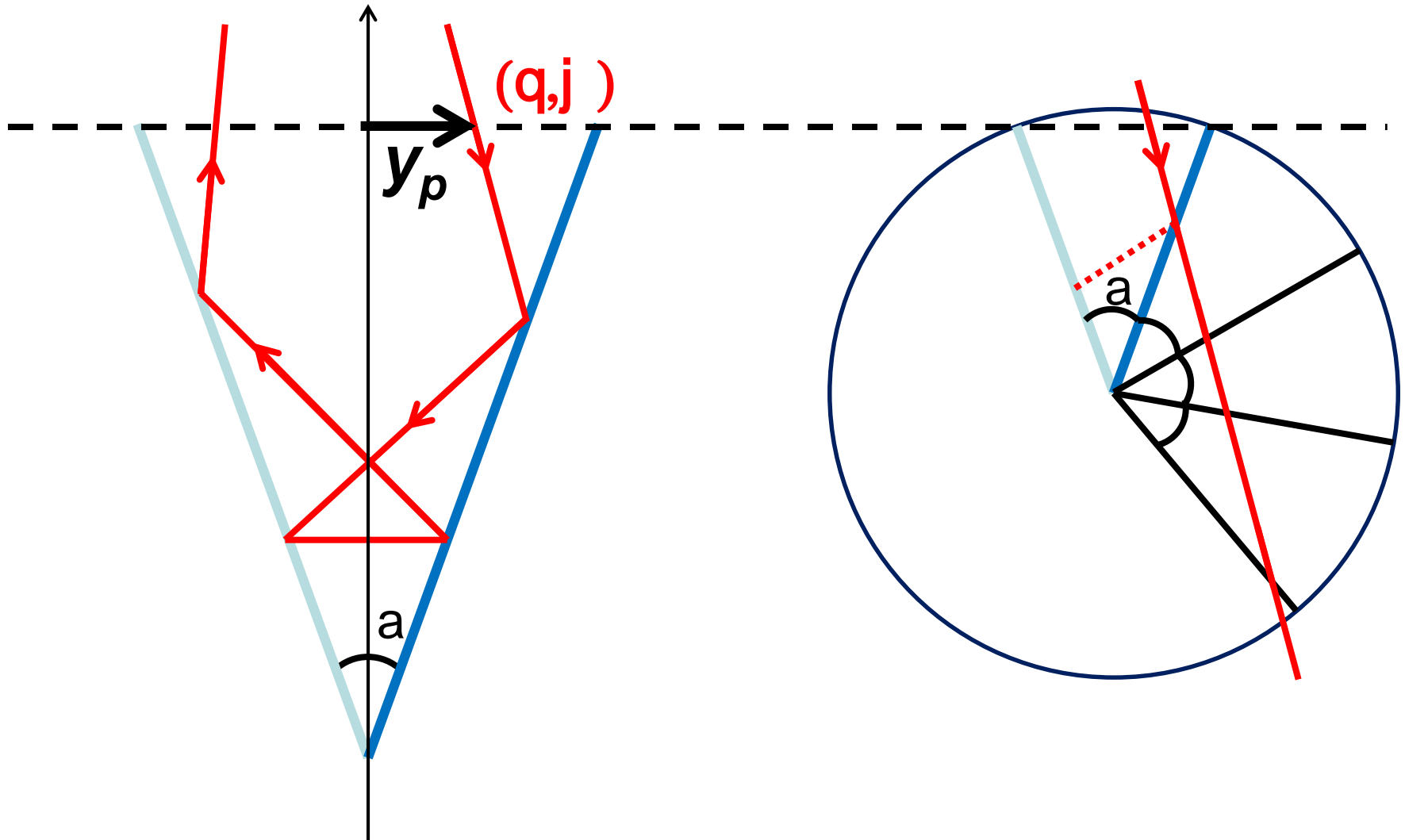
Cela se produit aussi dans une surface striée



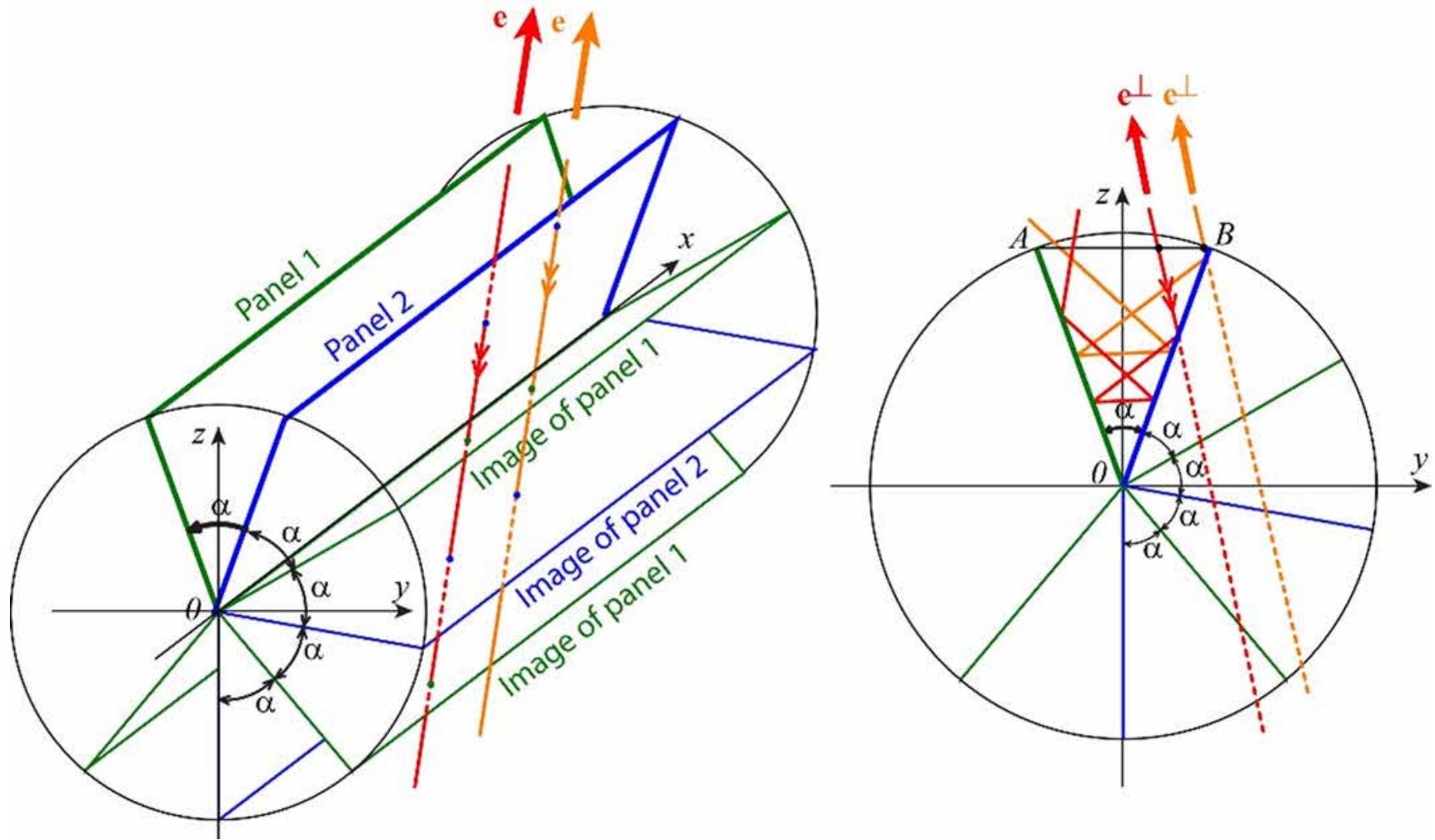
La couleur dépend fortement de l'angle



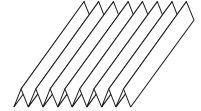
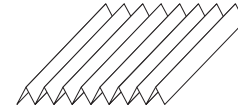
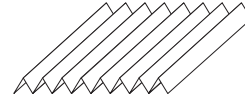
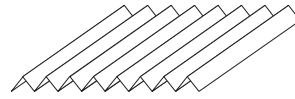
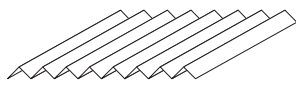
Modèle caléidoscopique de Dorian Saint-Pierre,  
Laboratoire Hubert Curien (2019)



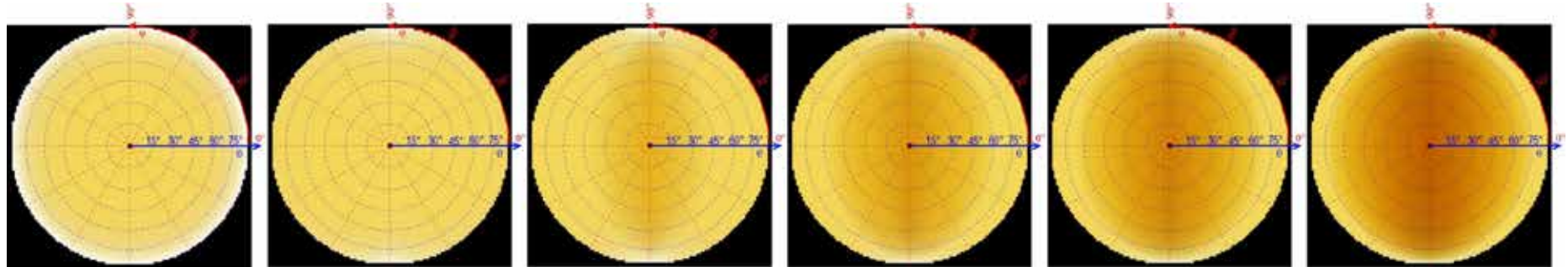
Modèle caléidoscopique de Dorian Saint-Pierre,  
Laboratoire Hubert Curien (2019)



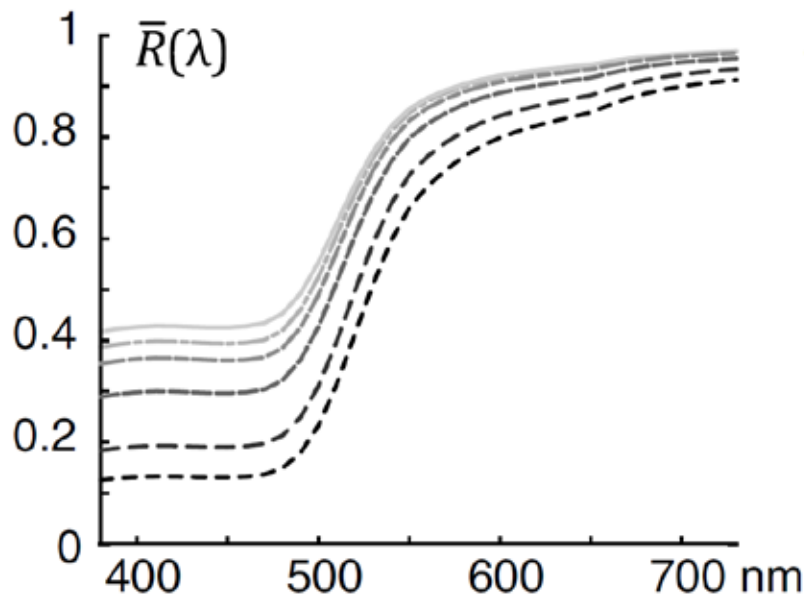
Surface plane



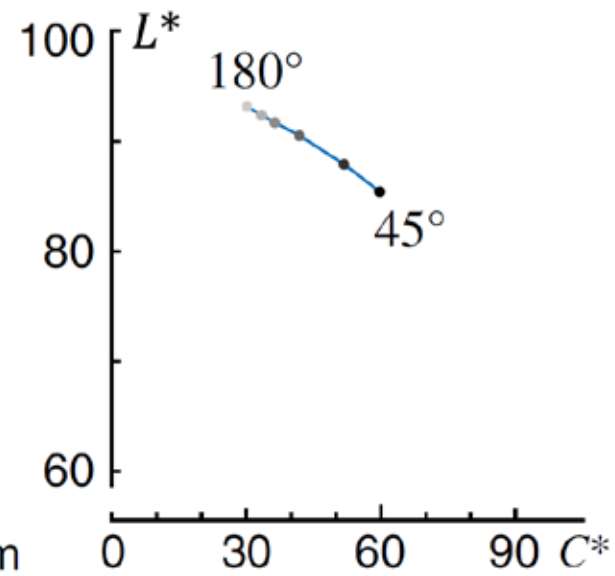
Or



(a)



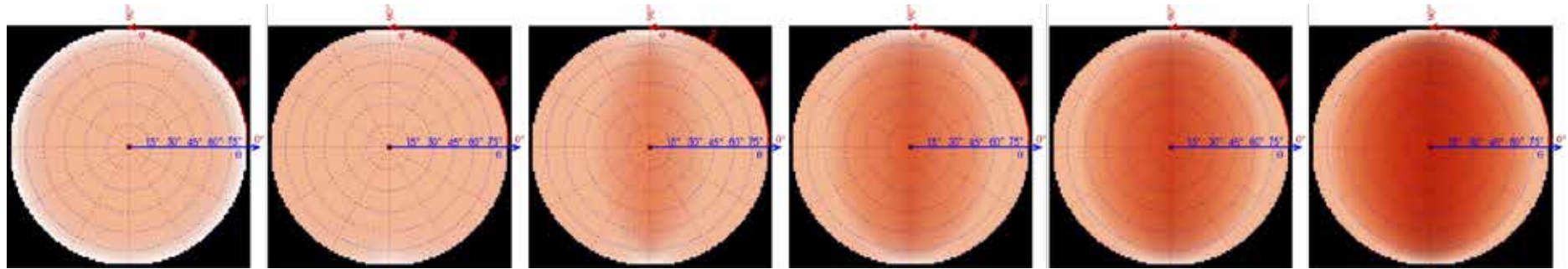
(b)



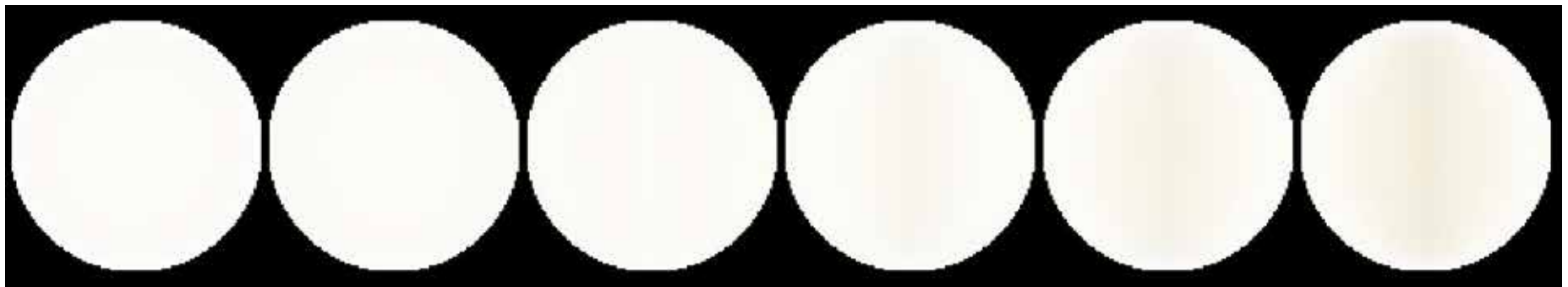
Surface plane

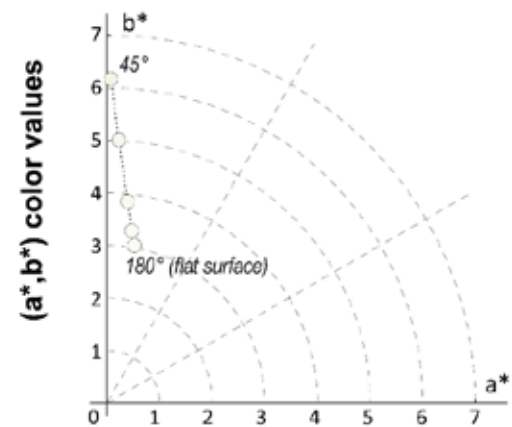
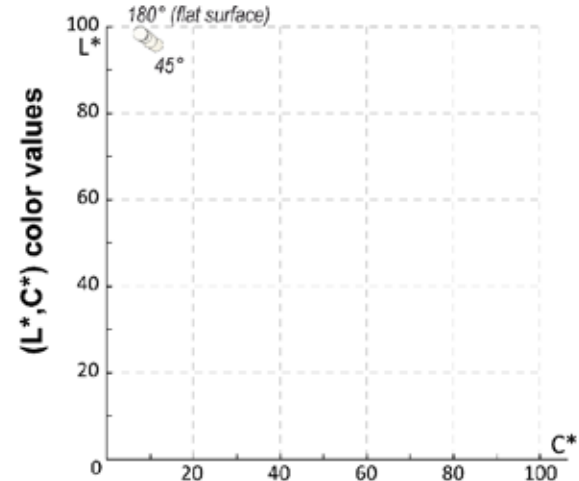
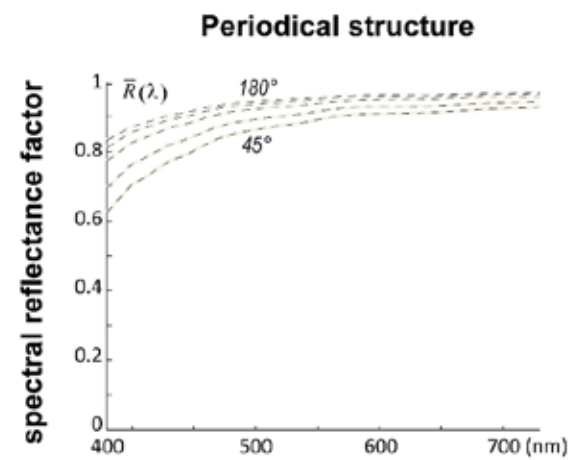
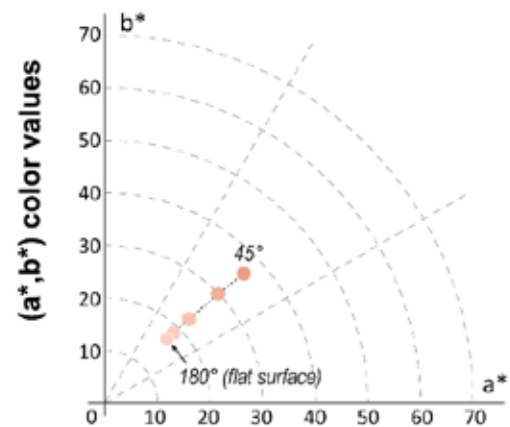
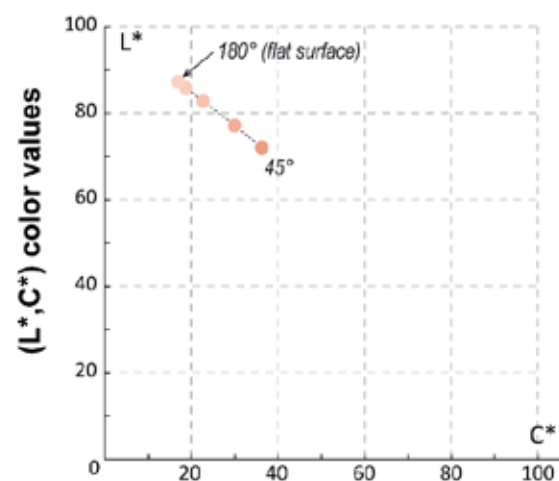
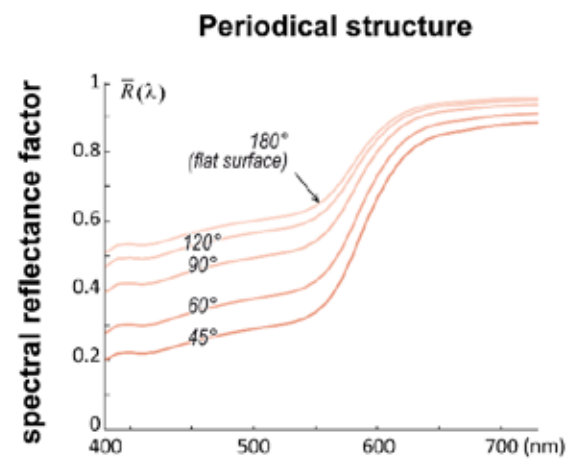
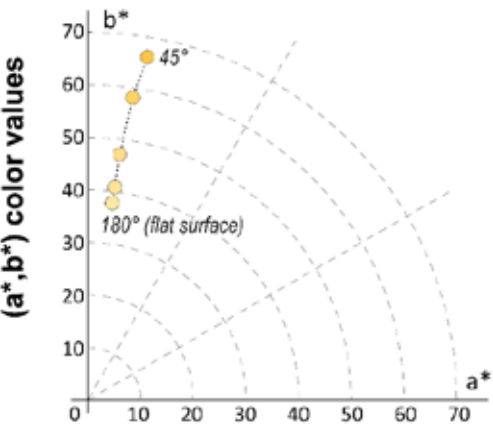
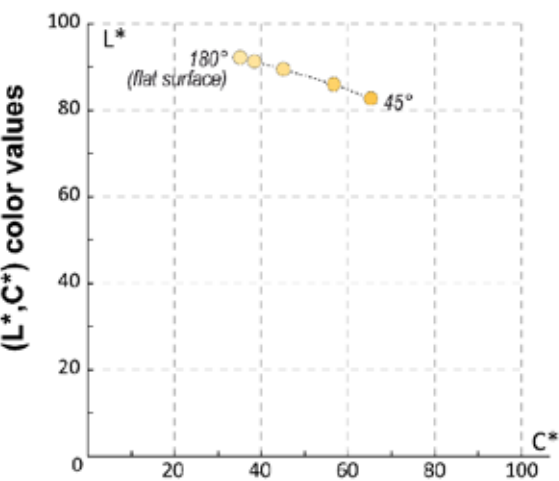
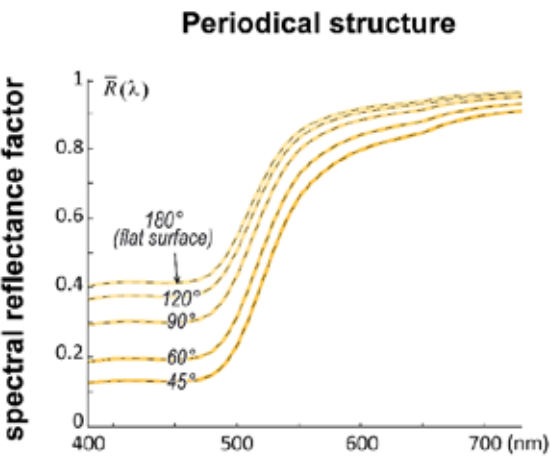


Cuivre

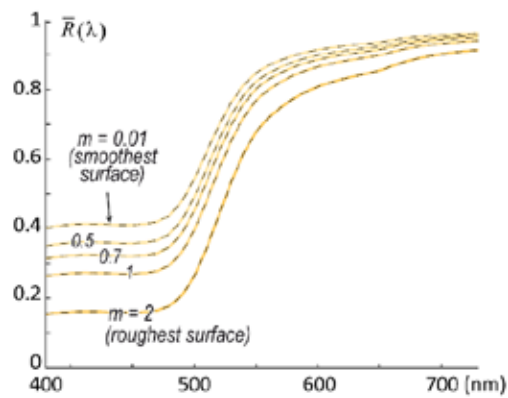


Argent

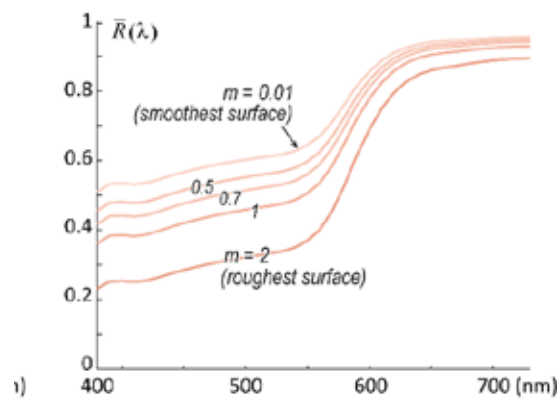




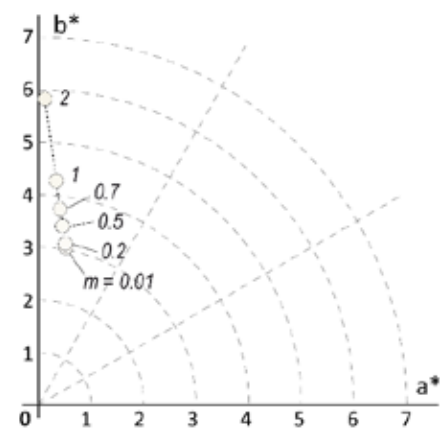
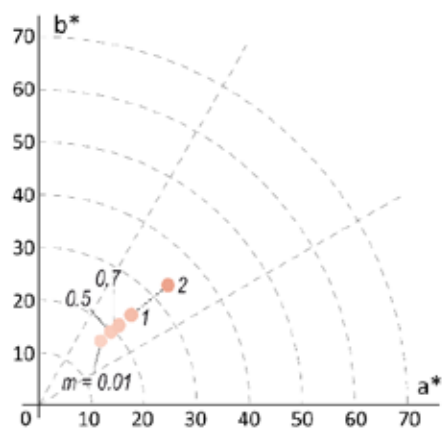
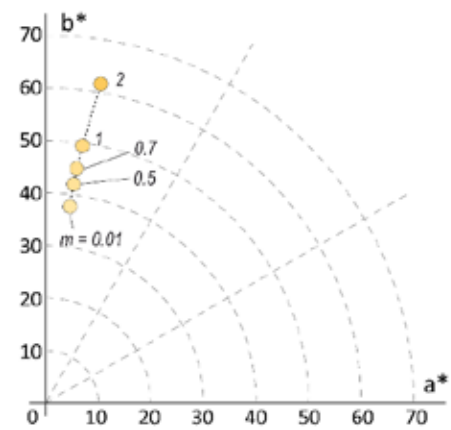
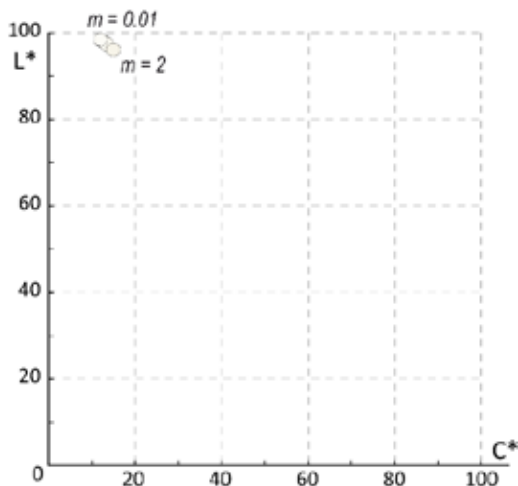
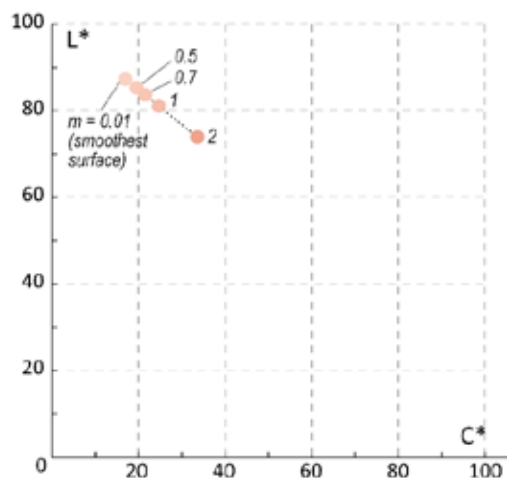
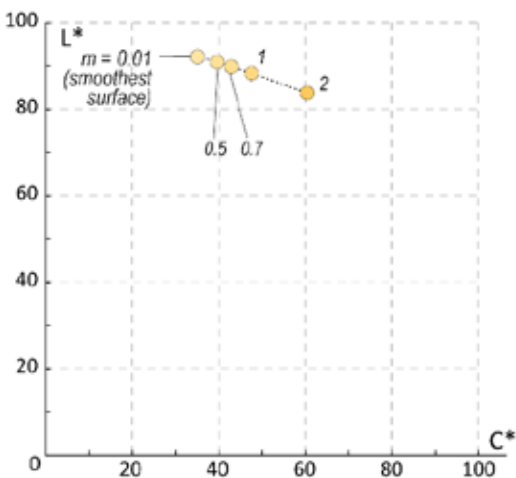
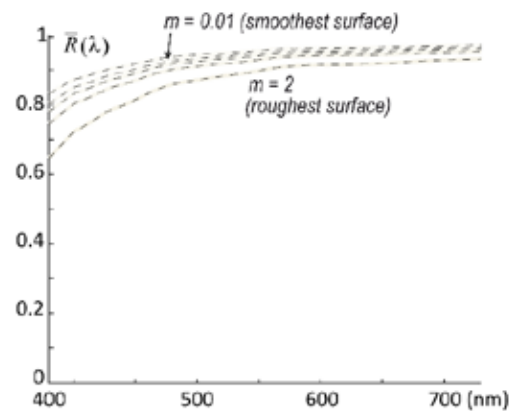
Random structure



Random structure



Random structure





Or

Chris Knight

1993

Argent massif, intérieur doré



Or

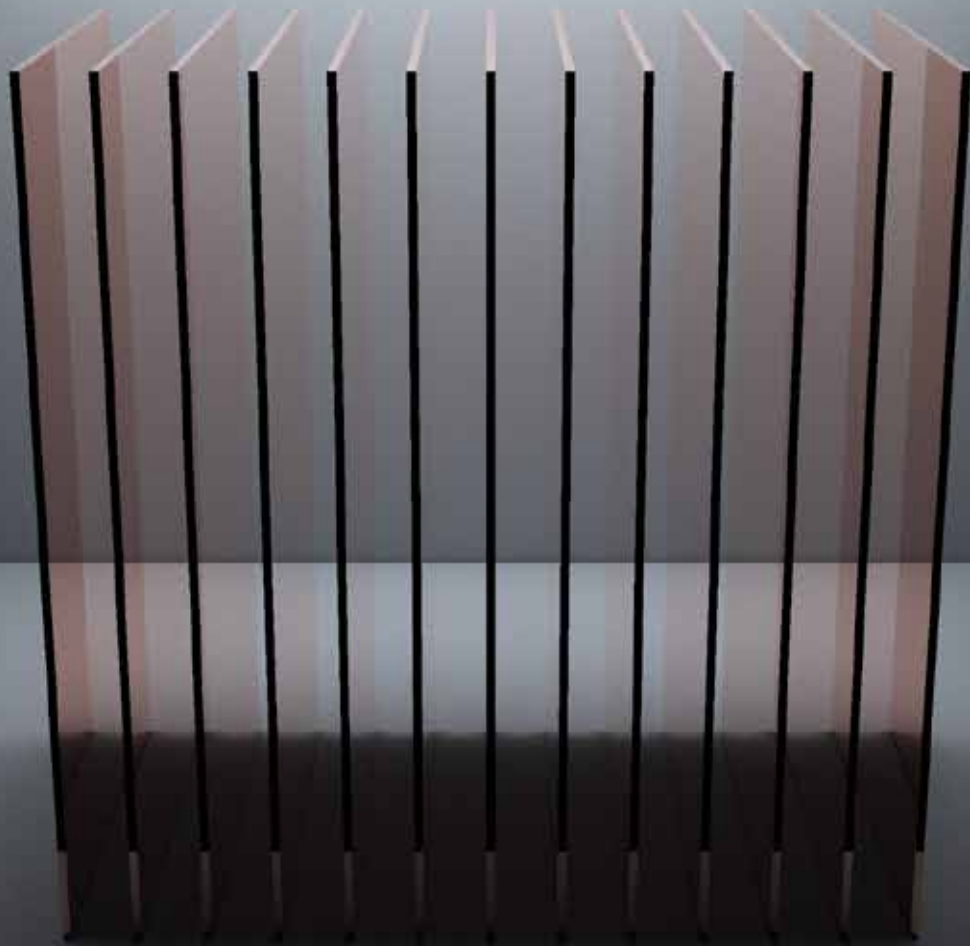
Alex Styles  
Garrard & Co, London  
1993  
Argent massif, intérieur doré



Cuivre



Cuivre











Argent





Christopher Lawrence  
1973  
Argent massif





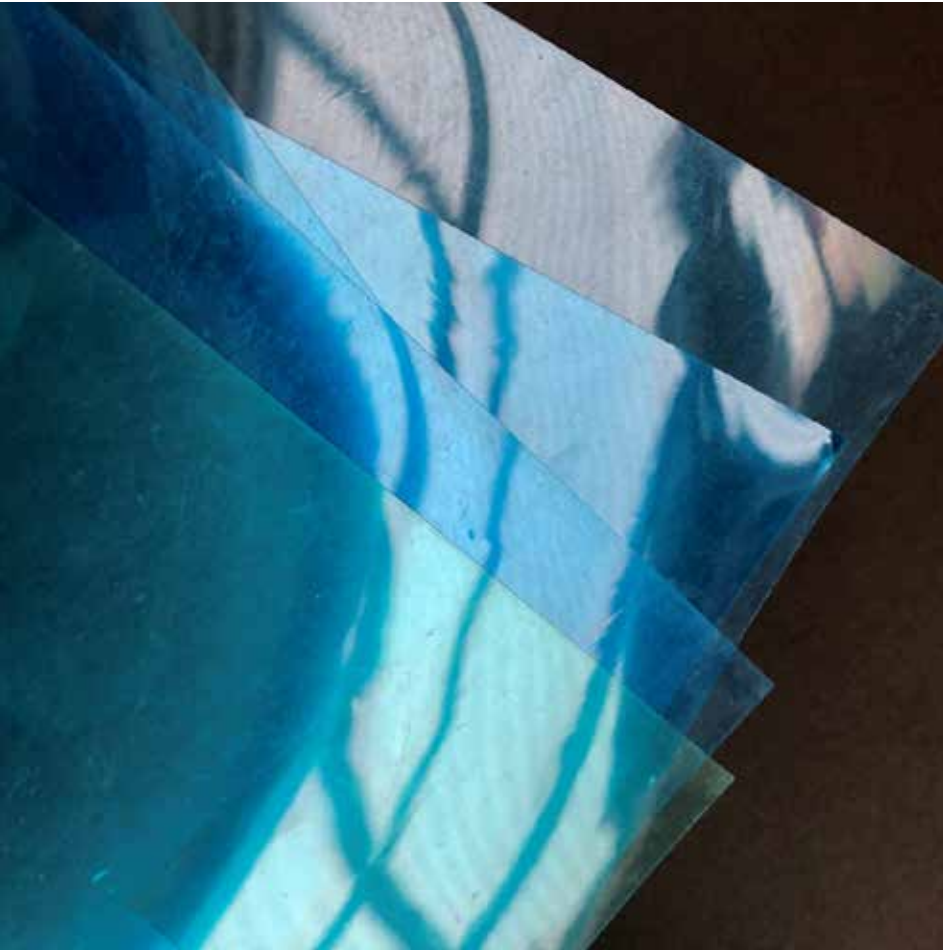
Jean Tétard  
Argent massif



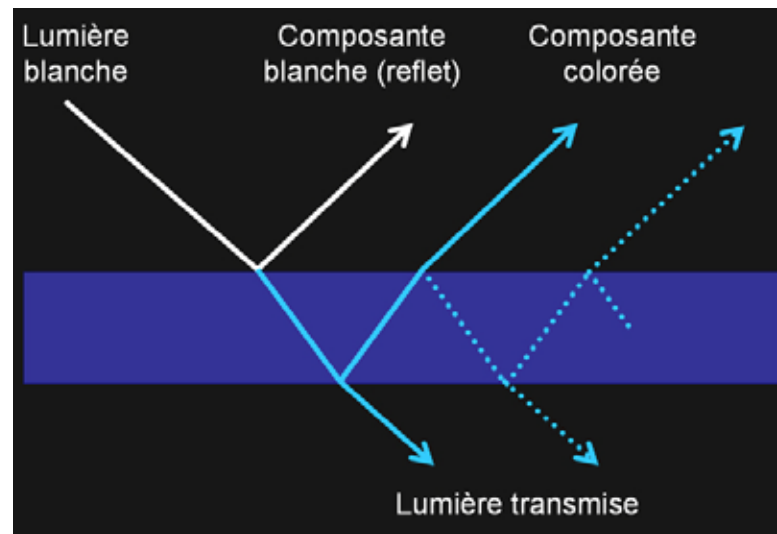
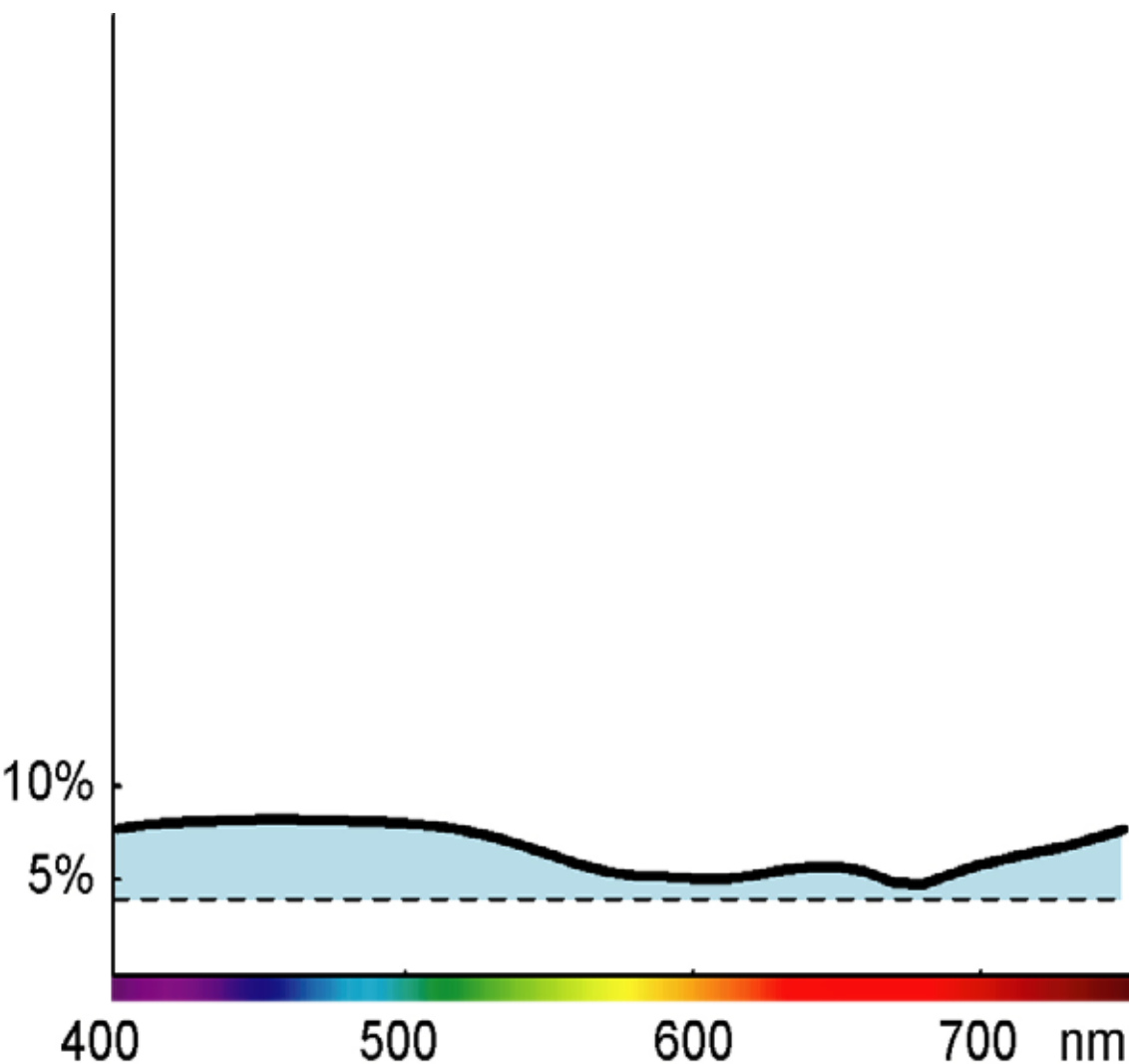
Van Eyck  
*Retable de l'agneau mystique*  
1432



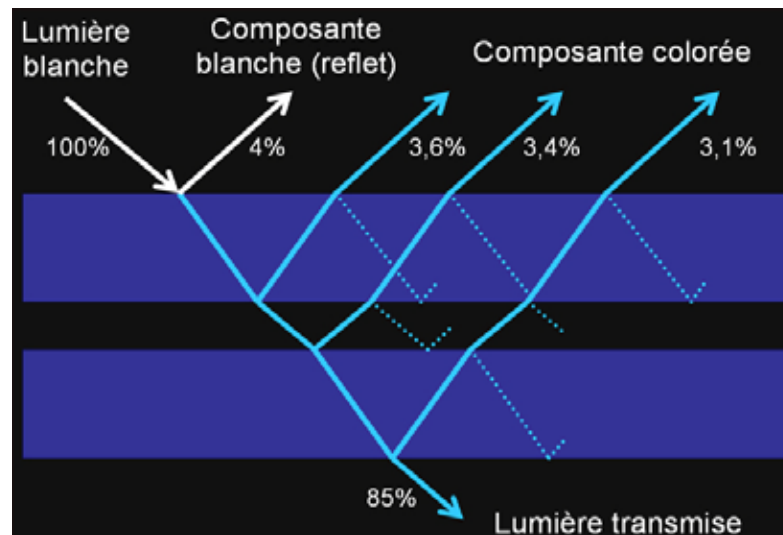
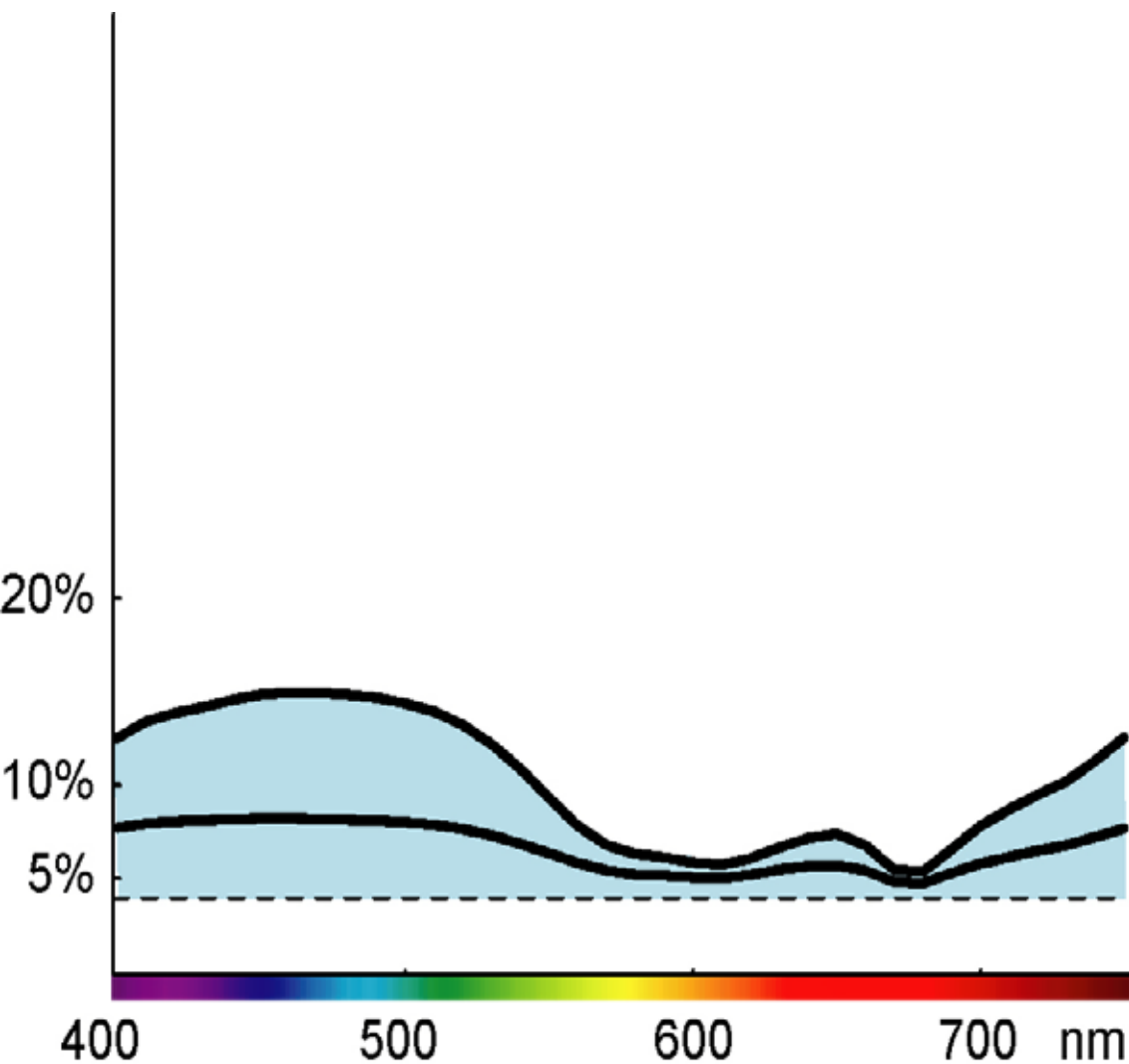
Les piles  
de films transparents



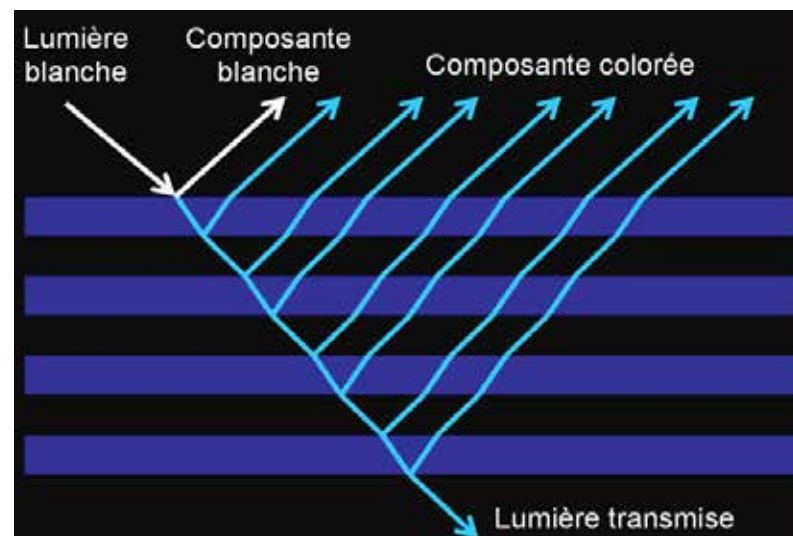
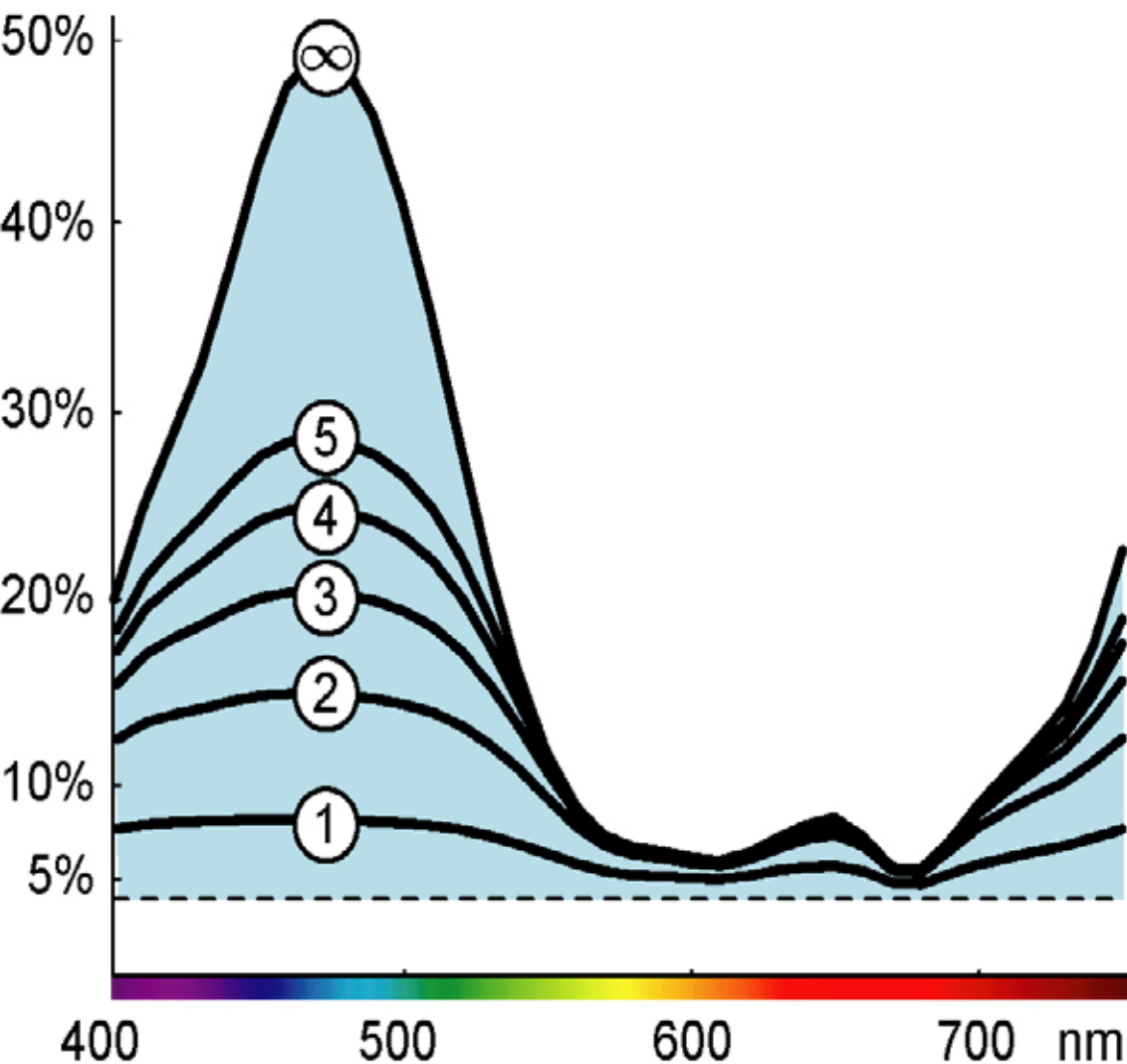
## Réflectance spectrale

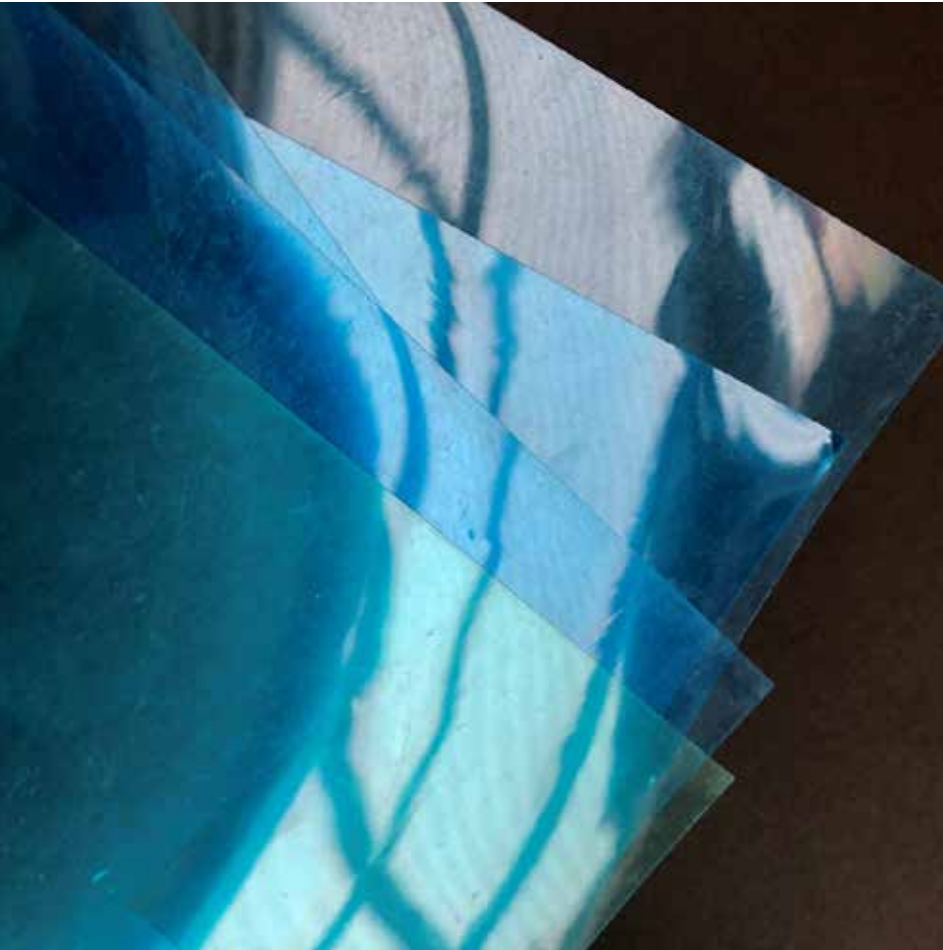


## Réflectance spectrale

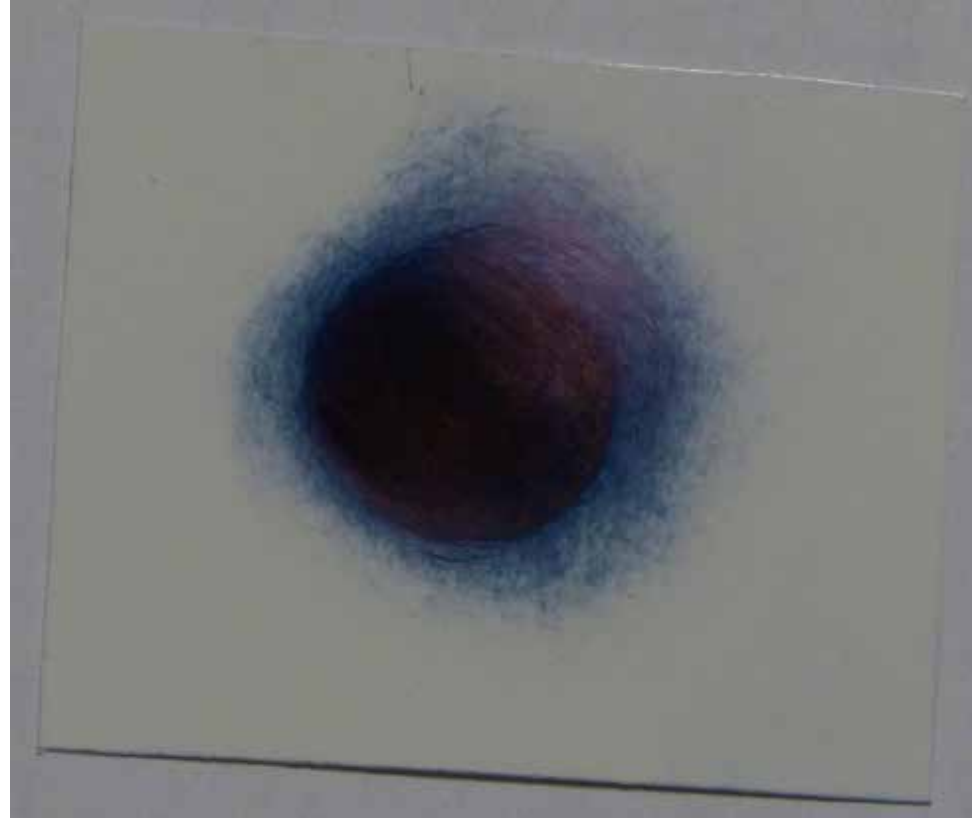
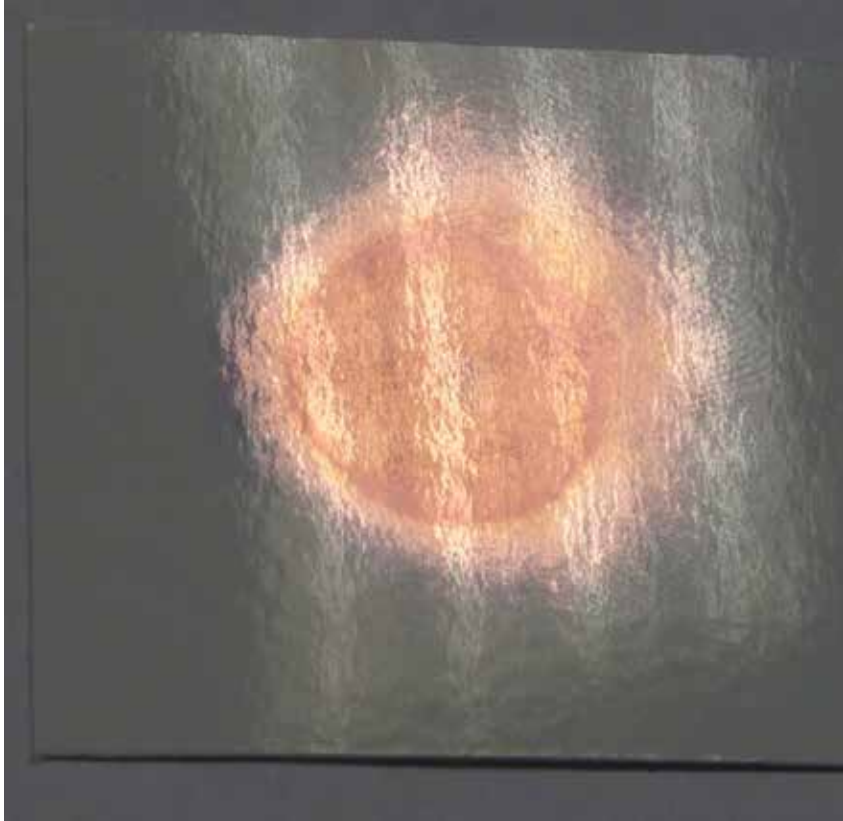


## Réflectance spectrale

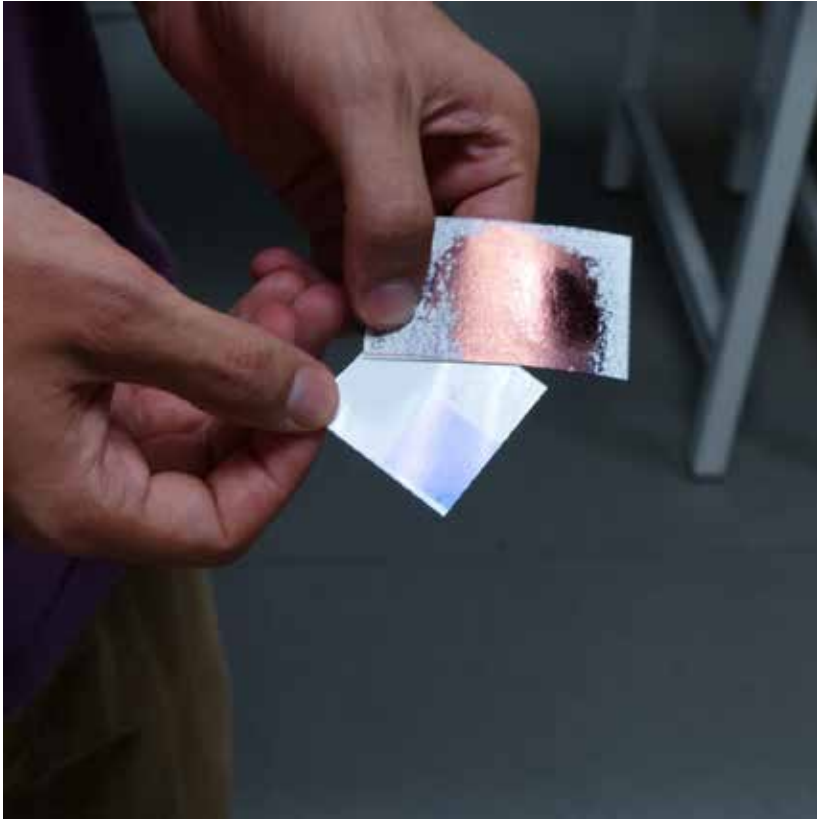








Le « bronzage » des encres



Le « bronzage » des encres



La couleur du métal est changeante

A quoi l'aspect métallique tient-il ?

Une forte réflectivité ?

Une forte spécularité ?



# Merci

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