ALUMINUM FOIL AS CATHODIC PROTECTOR TO PREVENT SILVER MIRRORING

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INTRODUCTION

Silver mirroring is one of the major problem we face in every photographic collection ,a new method has been developed using commercial aluminum foil as a cathodic protector to prevent it ,the new method has the advantage of being (cheap-available) so it can be applied in every archive or museum with no need of too much fund .

SILVER MIRRORING

Silver mirroring starts with an **Oxidation** of the silver particles by an oxidizer usually (H_2O_2),in presence of moisture the silver will oxidized into silver ions (Ag^+),the silver ions then **Diffusion** inside the emulsion layer to up ,then the silver ions will **Reaction** with the hydrogen sulphide (H_2S) forming (Ag_2S) witch is silver mirroring.then in keep contacting with the (H_2S) it will **Grow** in size not in number is called the (**ODRG**) model .

Showing the ODRG model for the silver mirroring

CATHODIC PROTECTION (SACRIFICIAL ANODE)

Simply sacrificing by less value metal to protect the metal we want to protect by providing by electrons instead of the ones it lost due to the RED-OX reactions .

THE IDEA

We all agree about the following facts :

1- the first step in silver mirroring is the oxidation of silver metallic (Ag) and turn it into unstable silver ions (Ag+).

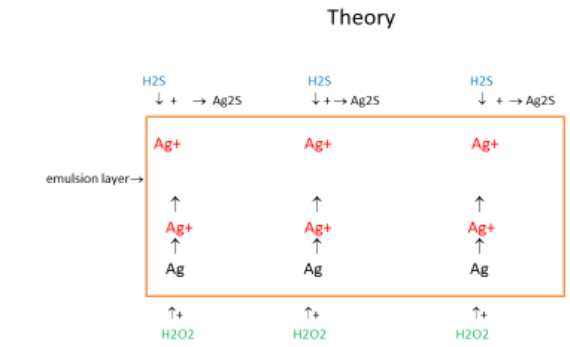
2- silver mirroring also occurs on the top surface of the emulsion layer .

3- silver (Ag) can oxidise aluminum (Al), in electron terms silver can take electrons from aluminum.

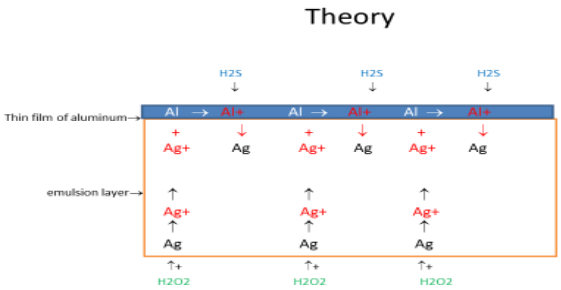
4- aluminum can be used as a sacrificial anode to silver .

5- we can sputter a thin film of the aluminum to any material.

So simply if we add a very thin film of aluminum foil on the top surface of the emulsion layer using sputtering technique the silver ions witch diffuse to the emulsion surface will hit the aluminum layer acting as a oxidizing agent and oxidize the aluminum resulting in reducing the silver ions(Ag^{+}) back into silver metallic (Ag).



Showing the normal silver mirrioing steps the ODRG model



Showing the result of using a thin film of AL witch will help reduce the silver ions Ag^{+} into silver metallic Ag again before forming the Ag_2S

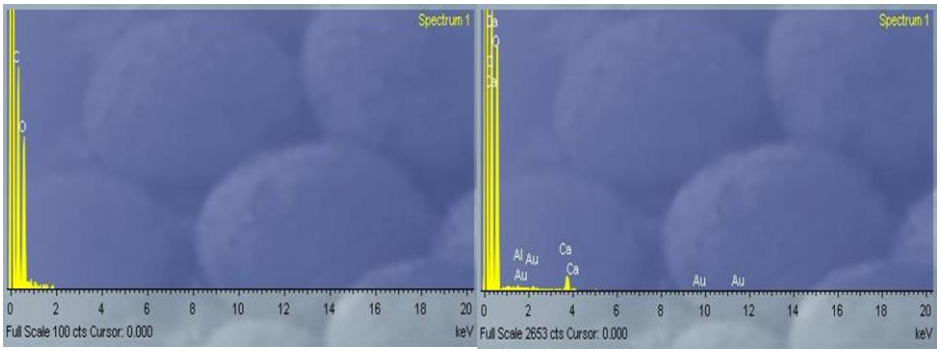
RESULTS

The table shows the results of using a **q 150r es magnetron sputtering machine** with both profiles.

Profile name	Fitted material	current	Sputtering time	Chamber pressuer	Aluminum existance	Color change
QT-TIMED GOLD	GOLD	40 MA	90 SEC	$7x10^{-2}$	NO	**NO**
QT-TIMED GOLD	GOLD	40 MA	100 SEC	$7x10^{-2}$	NO	**NO**
QT-TIMED GOLD	GOLD	40 MA	120 SEC	$7x10^{-2}$	NO	**YES**
QT-TIMED GOLD	GOLD	40 MA	180 SEC	$7x10^{-2}$	NO	**YES**
QT-TIMED GOLD	GOLD	40 MA	200 SEC	$7x10^{-2}$	NO	**YES**
QT-TIMED GOLD	GOLD	40 MA	300 SEC	$7x10^{-2}$	NO	**YES**
HENDY	ALUNIMUM	80 MA	90 SEC	$1x10^{-1}$	NO	**NO**
HENDY	ALUMINUM	80 MA	300 SEC	$1x10^{-1}$	YES	**YES**

The results using SEM-EDX

Showing failer to add the AL layer



Showing success to add the AL layer

Conclusion

using aluminum foil is applicable theoritically to prevent silver mirrirong for silver based photographic materials by sputtering it using a sputtering machine or using a piece of aluminum foil and just add it on the top serface of the photographic material .

reccomendation

further experimentaions is highly reccomended to make sure this method is working practicaly and has no bad effects on the long term .