



# agenda

proceeding

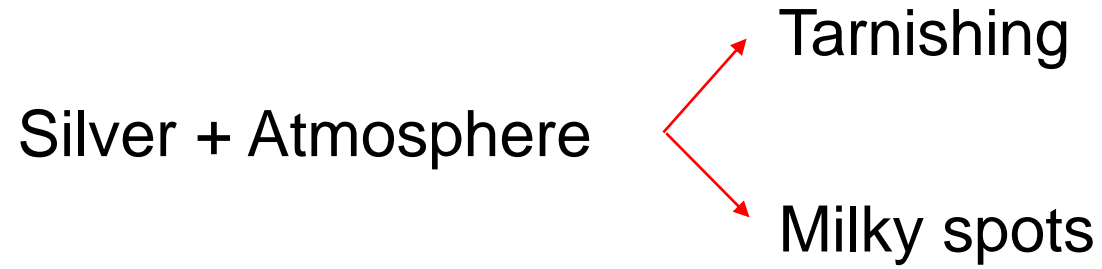
tarnishing

milky spots

defects

cleaning of tarnished silver



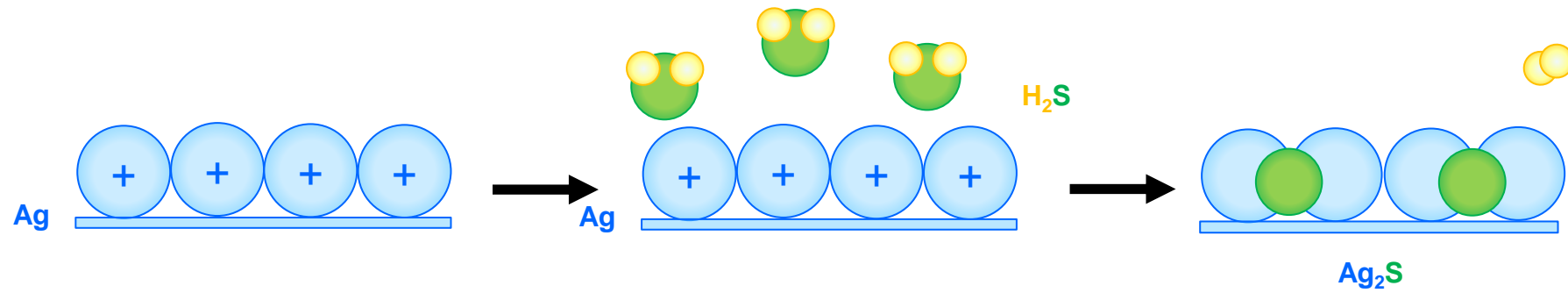


1. Analysis of the defects (Tarnishing and Milky Spots)
2. Artificial reproductions of defects to understand how they form
3. Potential processes to restore or avoid the defects



# tarnishing

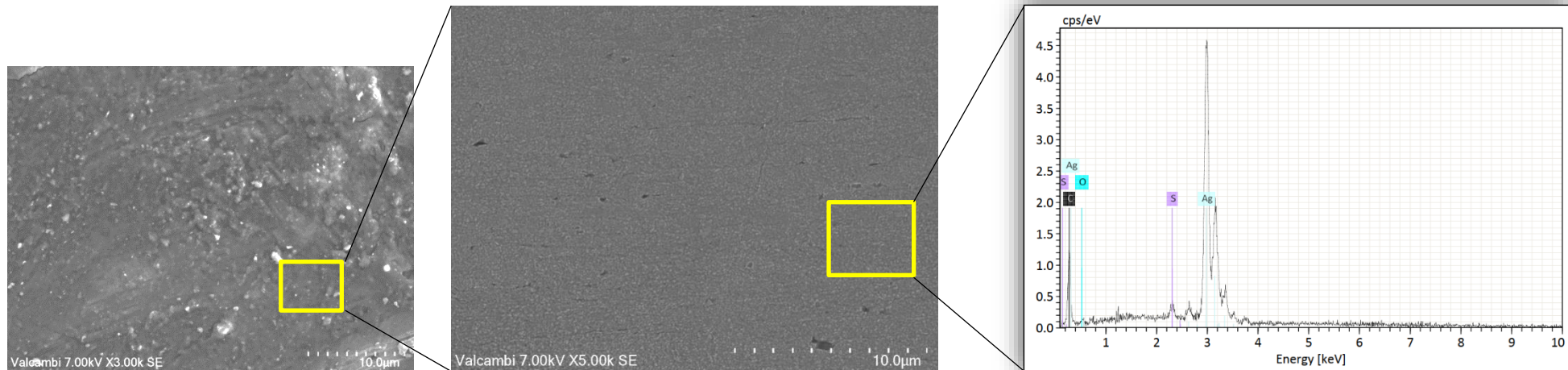
A traditional atmospheric problem





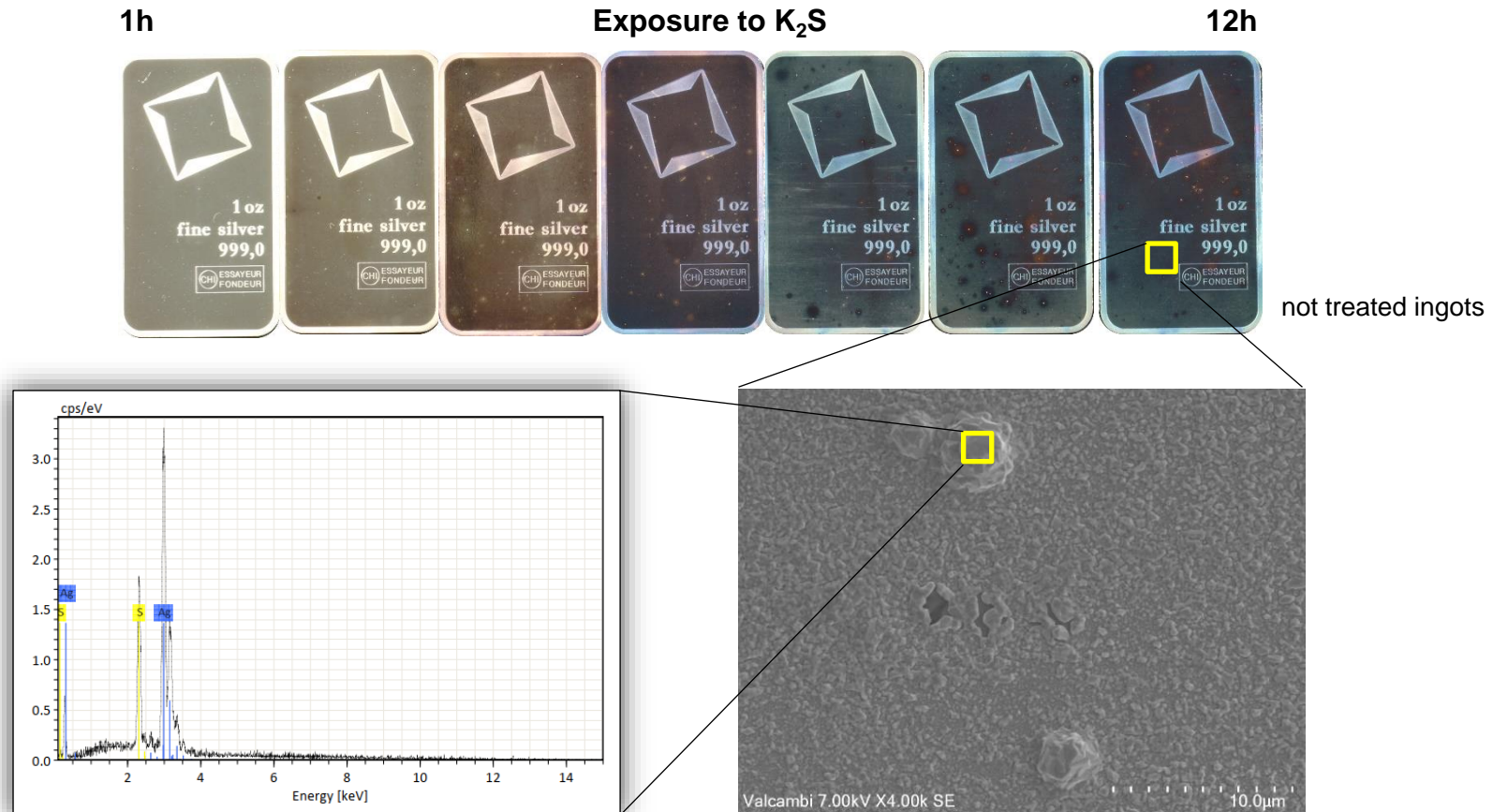
# tarnishing

Under the Scanning Electron Microscope (SEM)

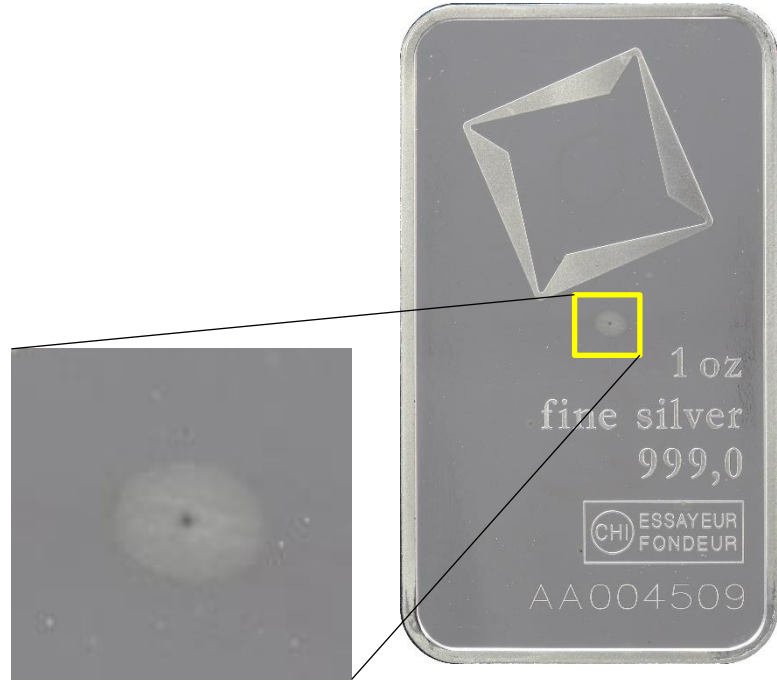


# tarnishing

Artificially reproduced and analysed

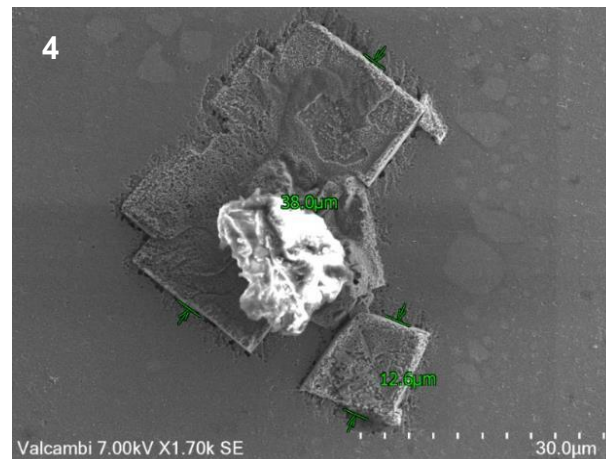
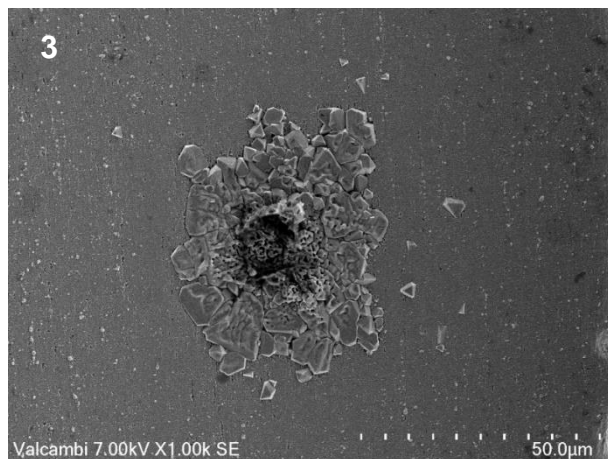
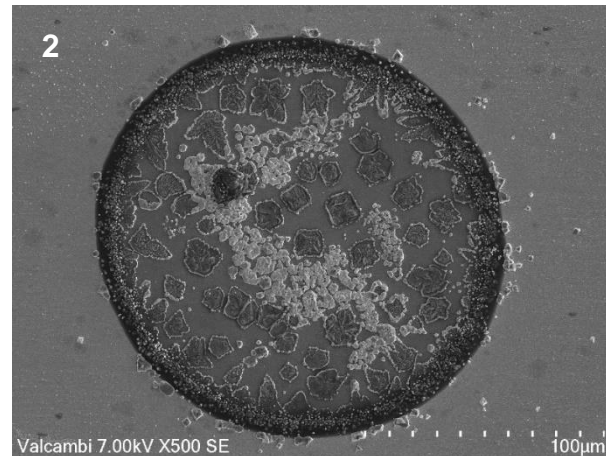
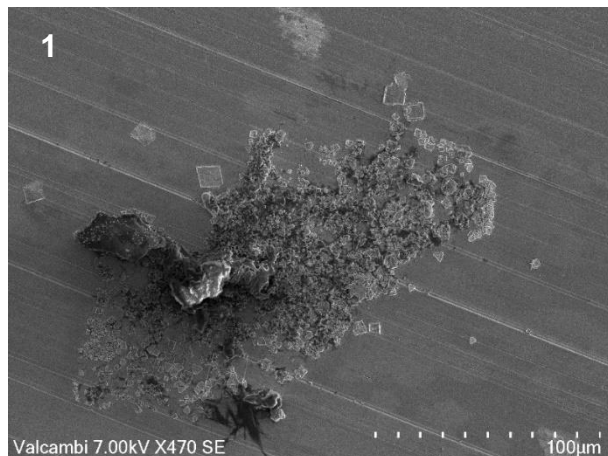


# milky spots



# milky spots

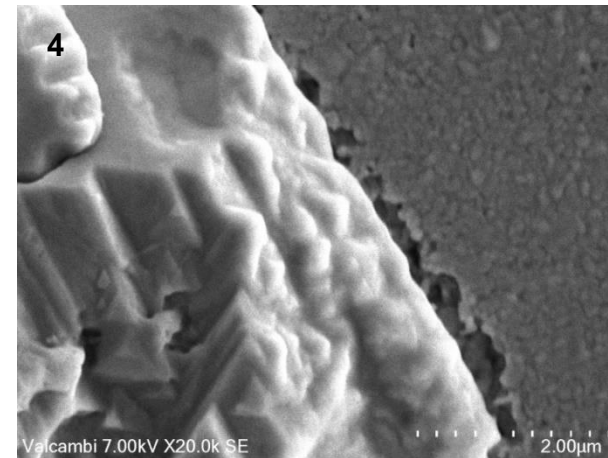
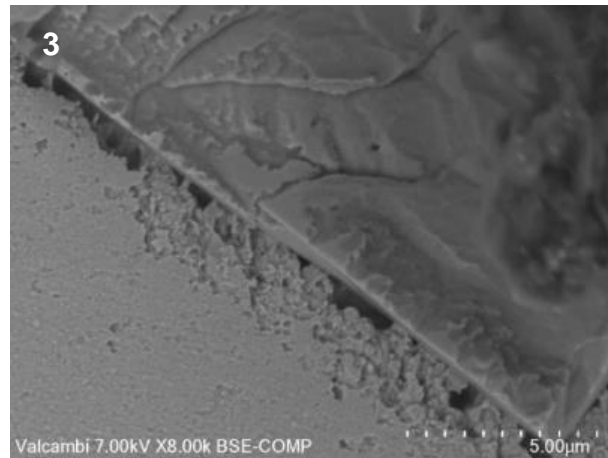
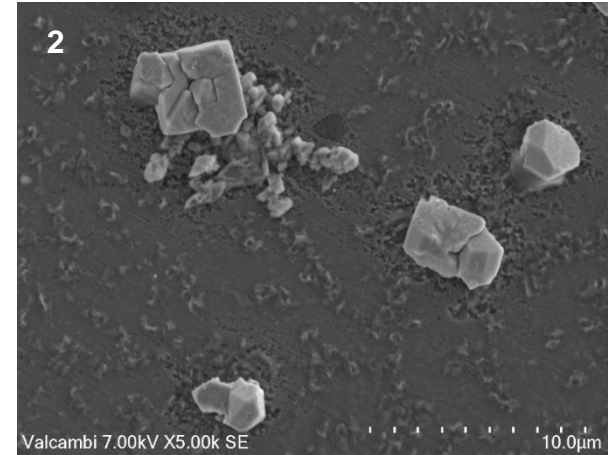
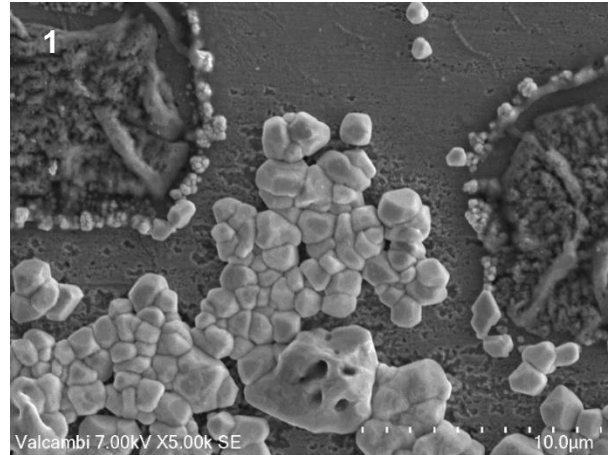
Under the Scanning Electron Microscope (SEM)





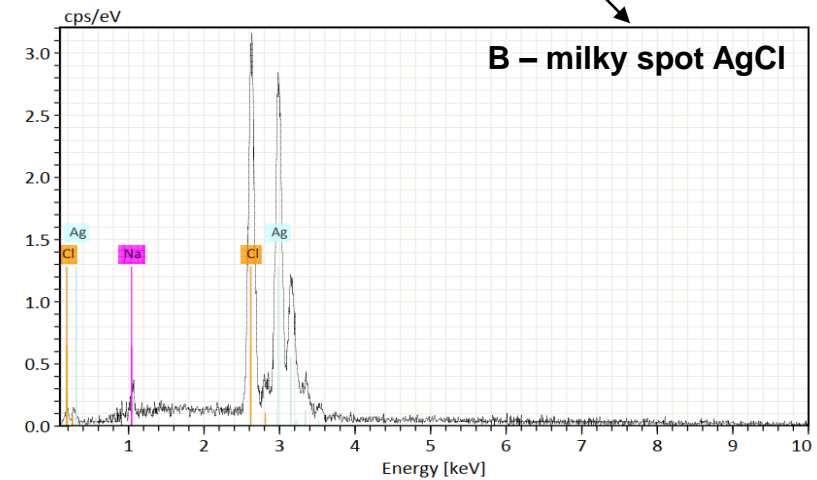
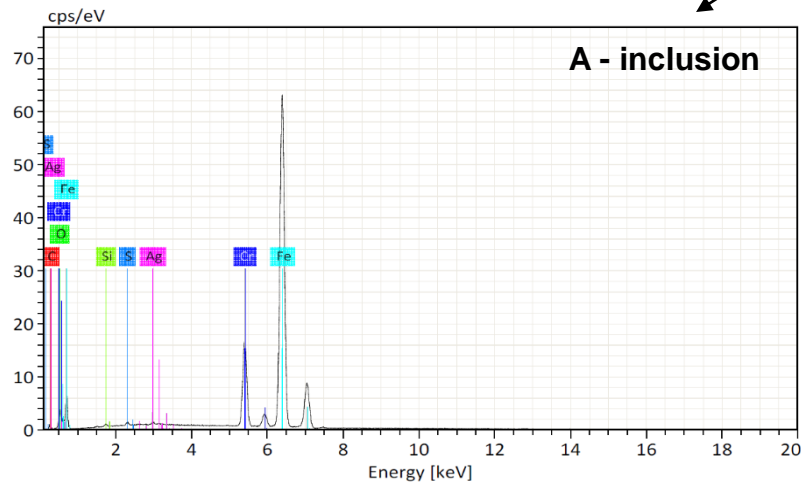
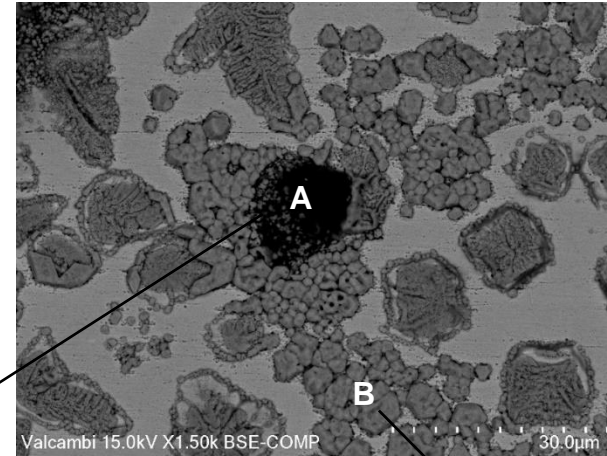
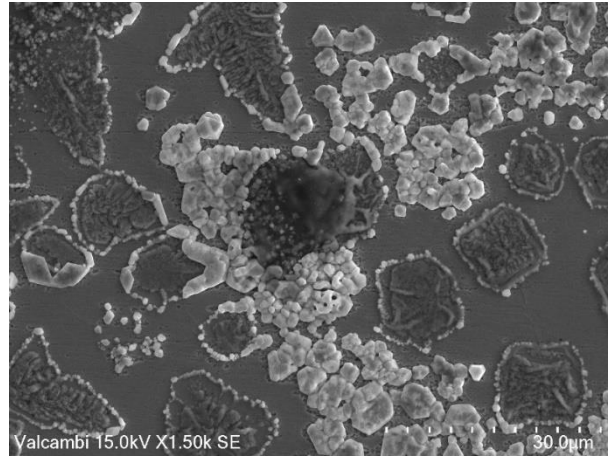
# milky spots

Under the Scanning Electron Microscope (SEM)



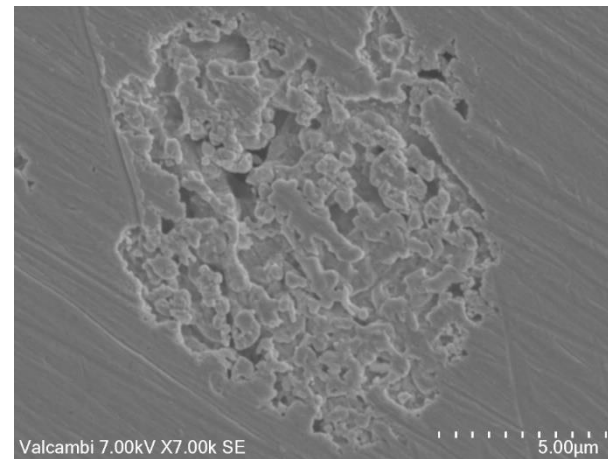
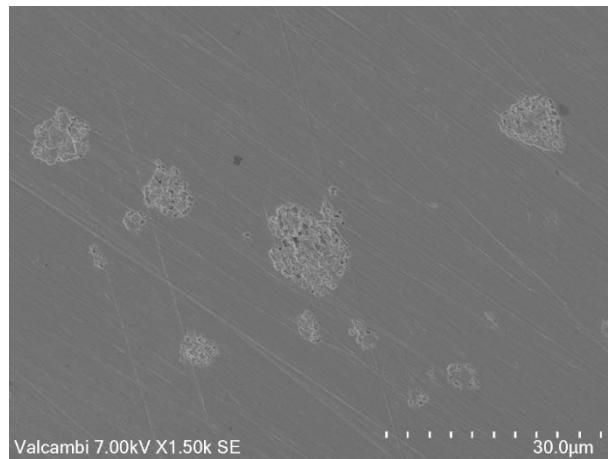
# milky spots

Under the Scanning Electron Microscope (SEM)



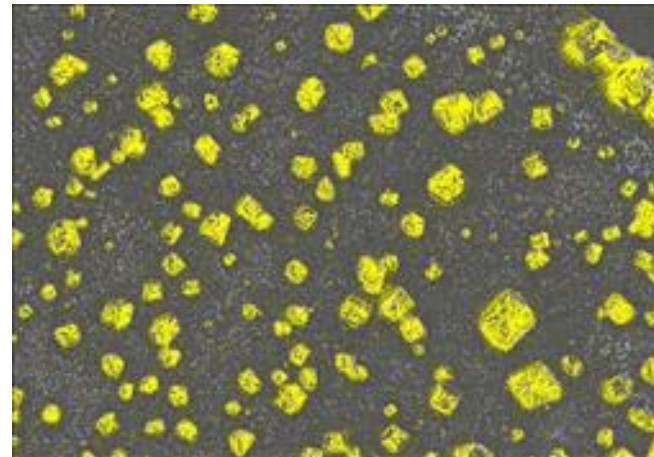
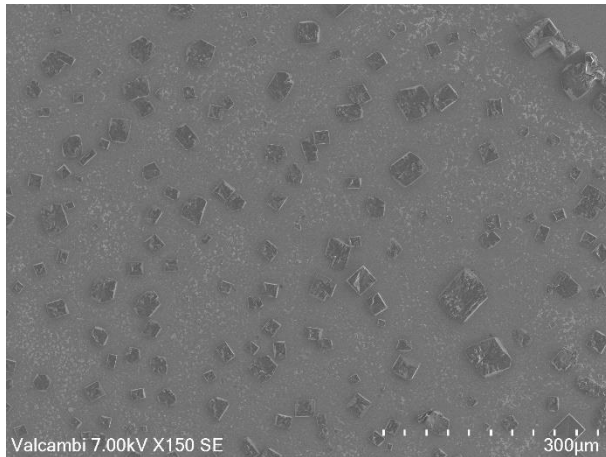
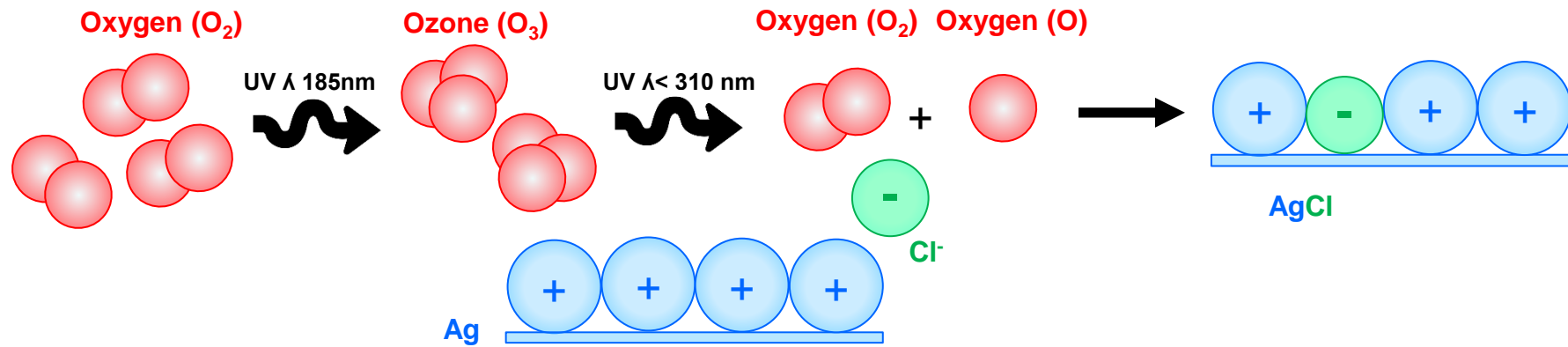
# milky spots

Under the Scanning Electron Microscope (SEM) after having been removed

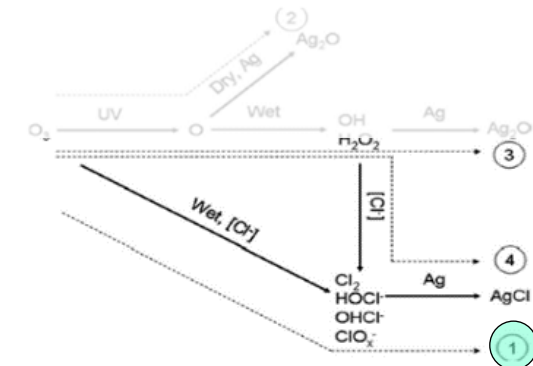


# milky spots

Artificially reproduced



Salt distribution



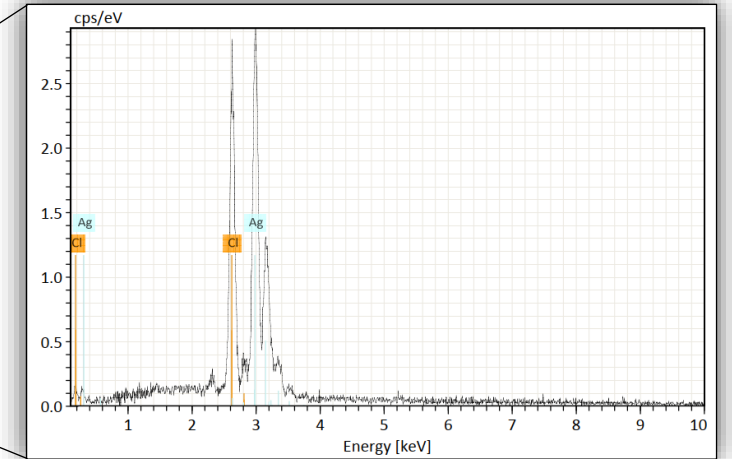
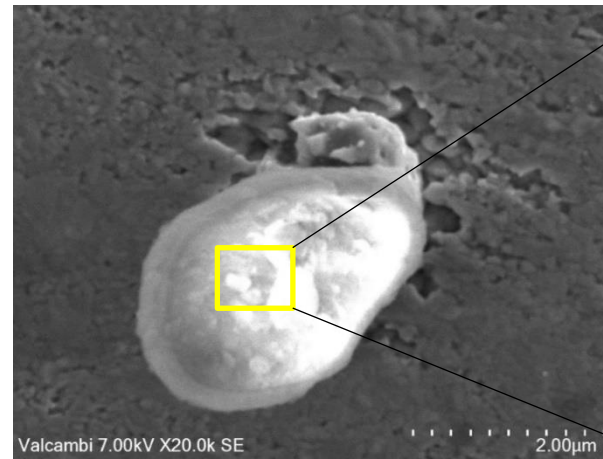
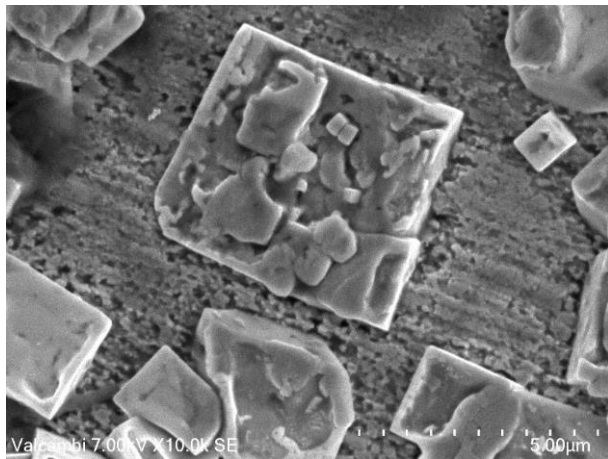
D.Liang et al. «Effects of Sodium Chloride particles, Ozone, UV and relative Humidity on atmospheric Corrosion of Silver» Journal of the Electrochemical Society. March 2010





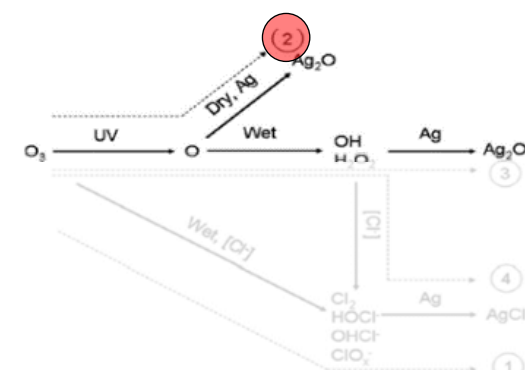
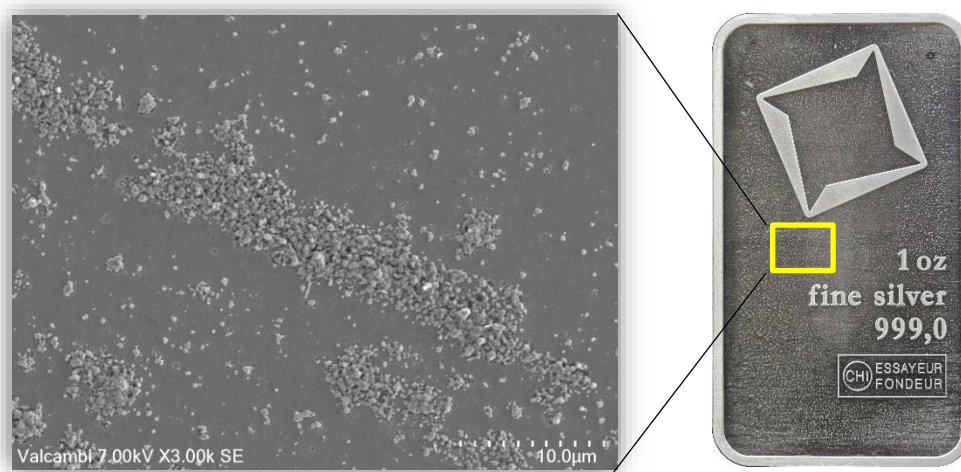
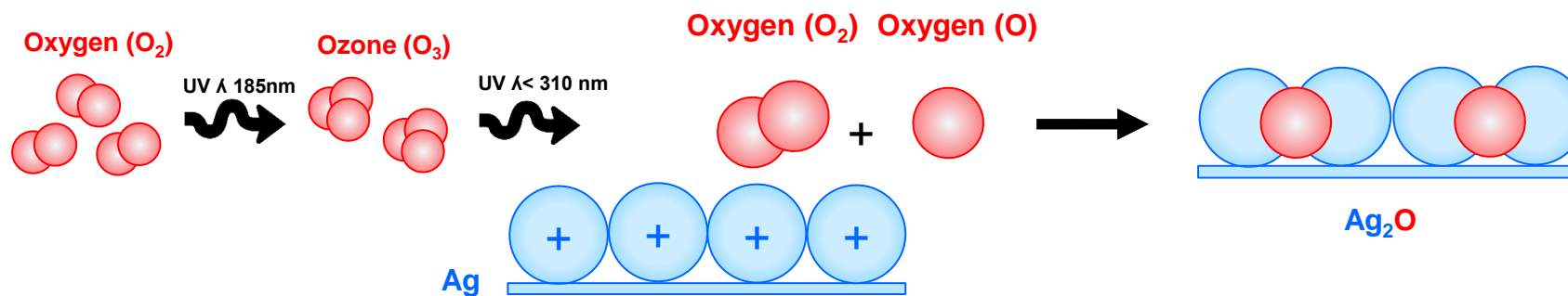
# milky spots

Artificially reproduced and analysed



# milky spots

Other morphologic defects: Oxidation

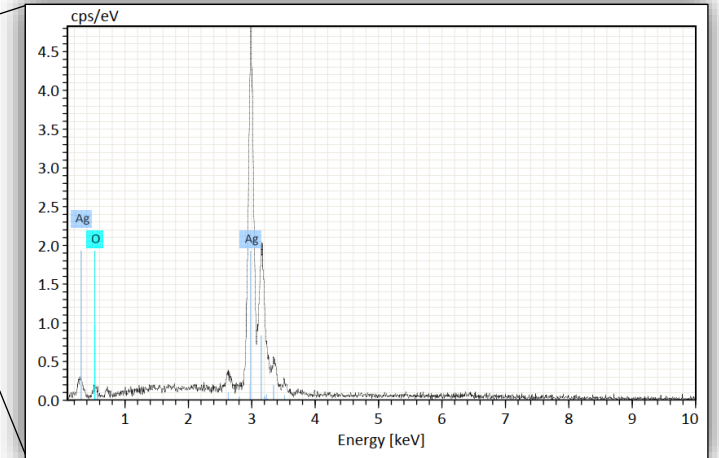
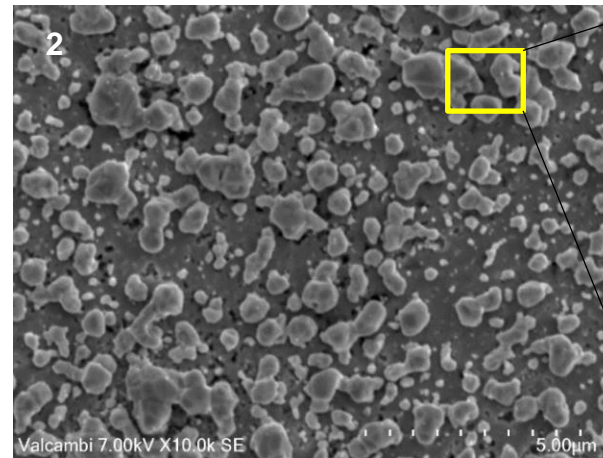
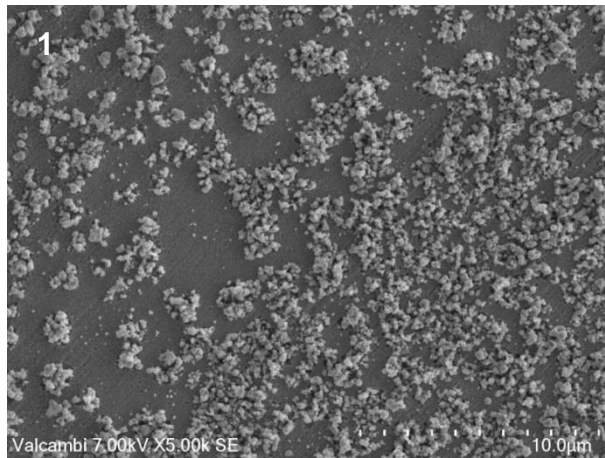


D.Liang et al. «Effects of Sodium Chloride particles, Ozone, UV and relative Humidity on atmospheric Corrosion of Silver» Journal of the Electrochemical Society. March 2010



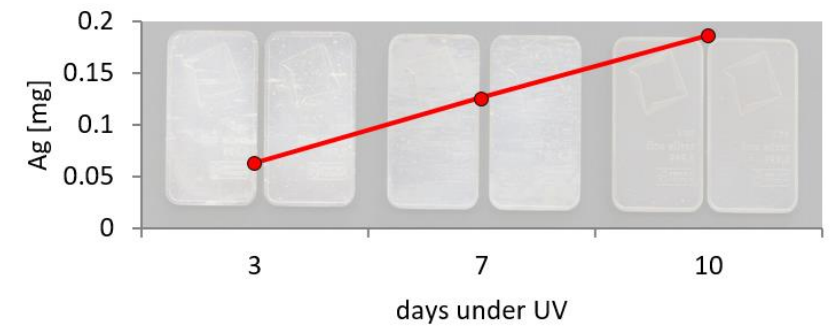
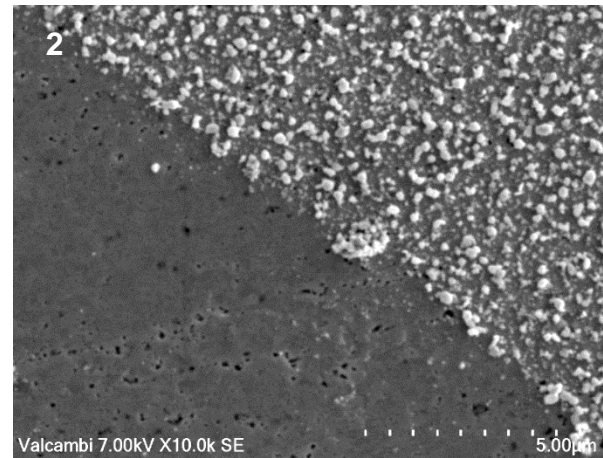
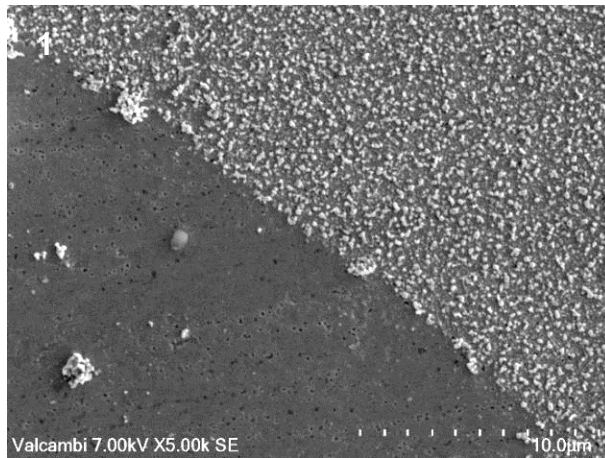
# milky spots

Other morphologic defects: Oxidation



# milky spots

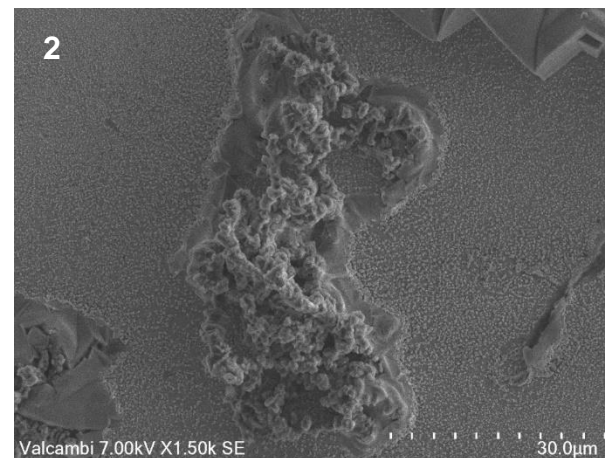
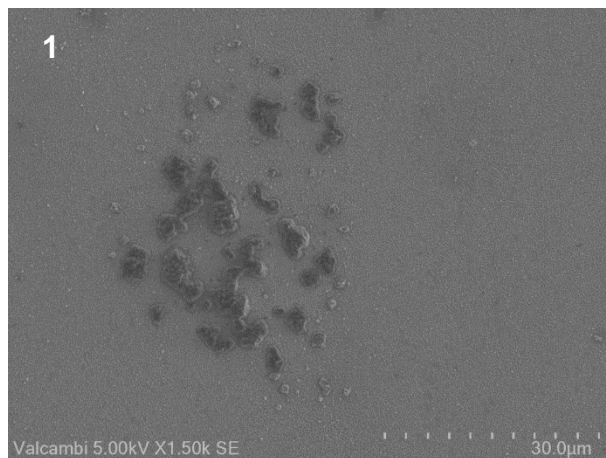
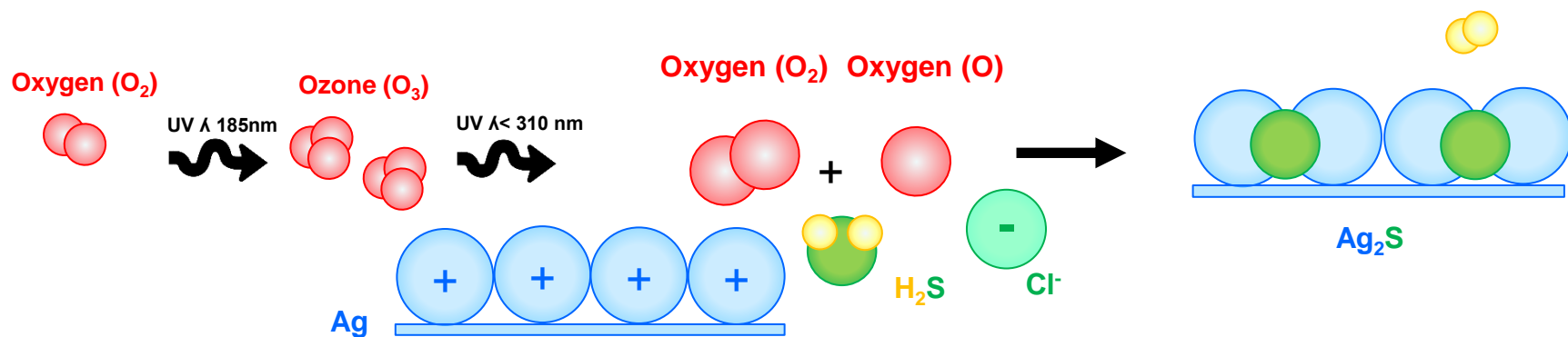
Other morphologic defects: Oxidation





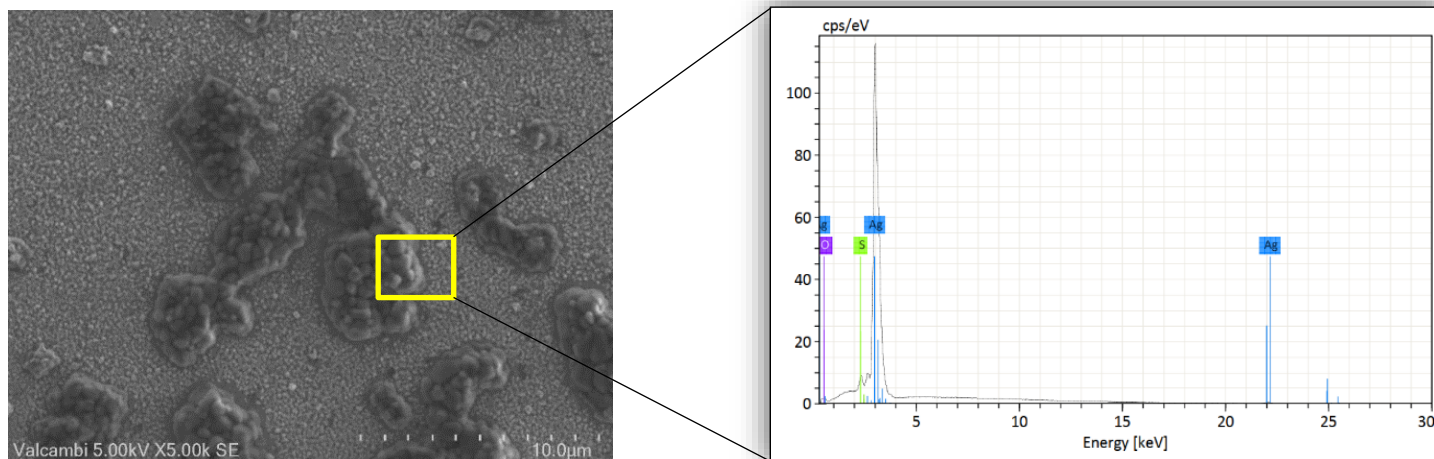
# milky spots

Other morphologic defects: Sulfidation



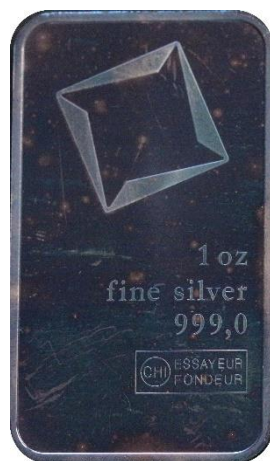
# milky spots

Other morphologic defects: Sulfidation

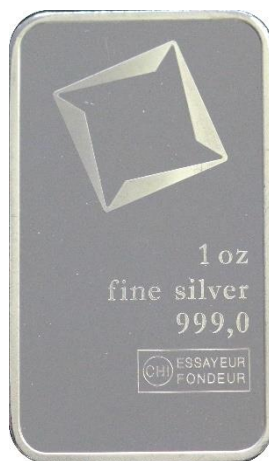


# defects

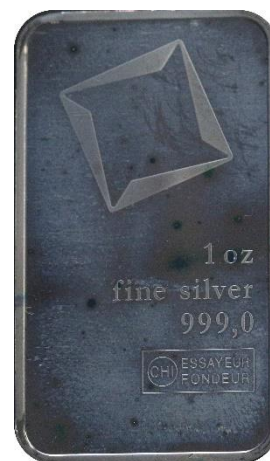
Not treated versus treated ingots



not treated



treated



not treated



treated



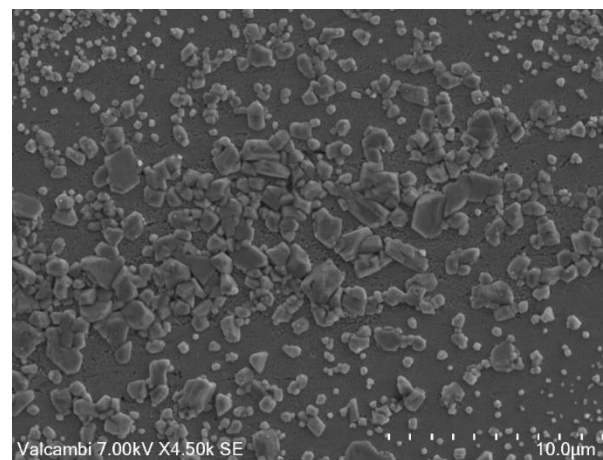
# defects

What can be restored

Tarnish



~~Silver oxidation~~

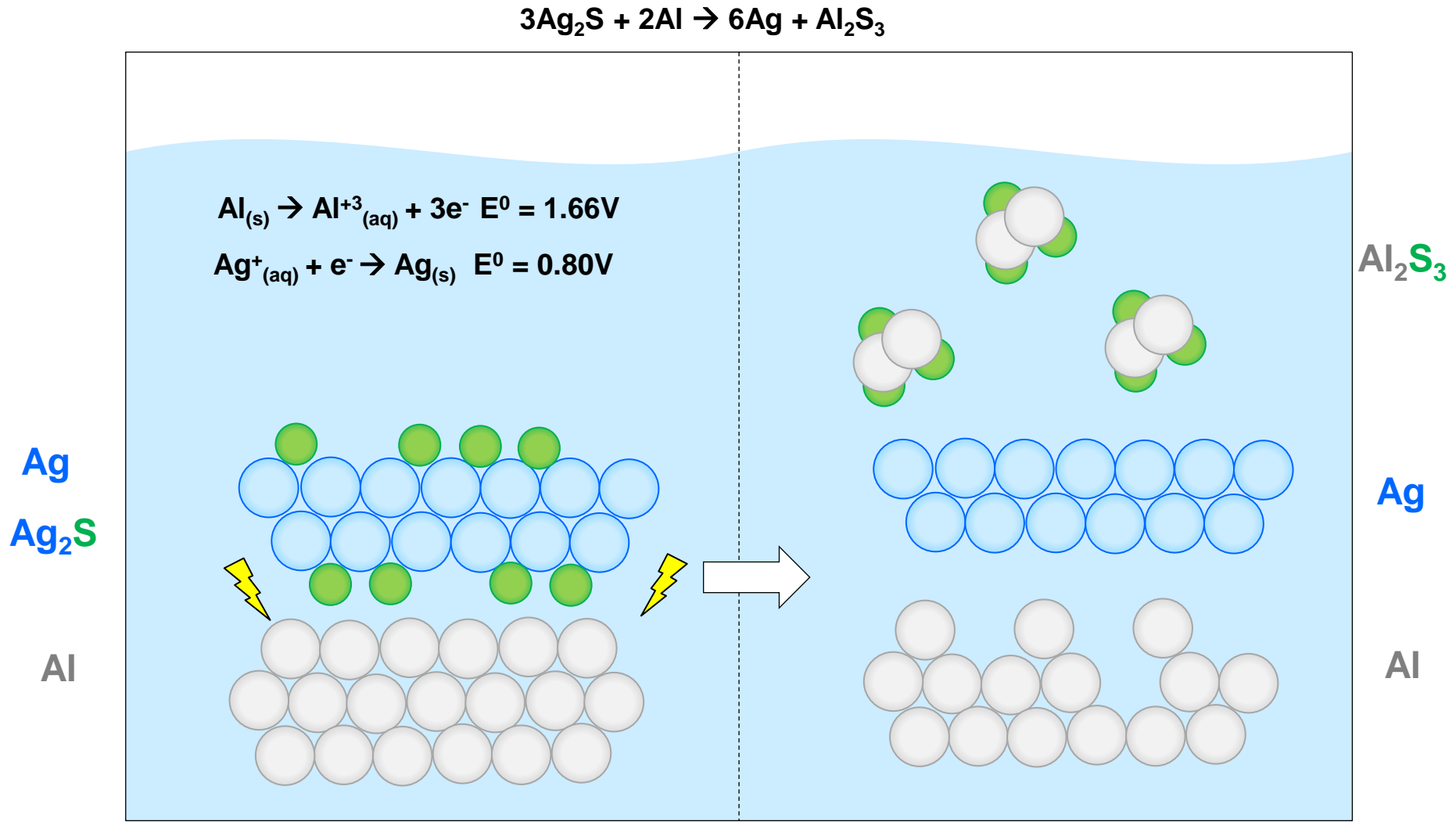


~~Milky spots~~

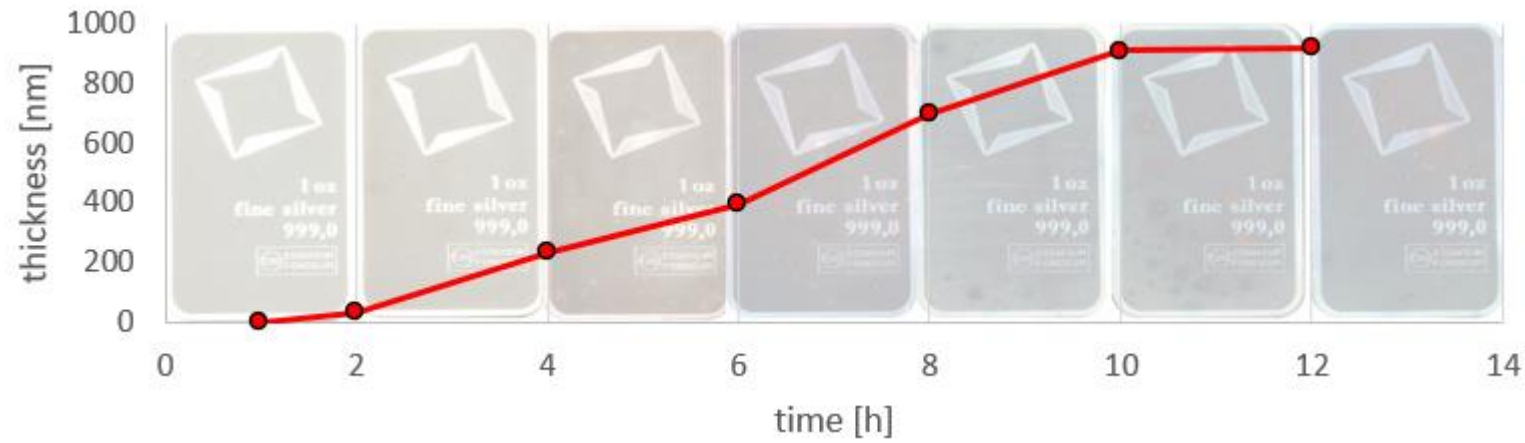




# Cleaning of tarnished silver



# Cleaning of tarnished silver



# Conclusion

1. Both defects come natural and slow after a certain time
  2. Tarnishing can be removed and bars can be fully restored
  3. Milky spots can be removed but leave a microscopically damaged surface
  4. Incubation time of both defects are variable and can be extended with protective treatments
- 



# R&D team



Alessia Sironi  
Head of Laboratory  
p. +41 91 695 5355  
f. +41 91 695 5365  
alessia.sironi@valcambi.com



Luca Maerna  
Laboratory  
p. +41 91 695 5358  
f. +41 91 695 5365  
luca.maerna@valcambi.com



Pedro Pianezzi  
Laboratory  
p. +41 91 695 5311  
f. +41 91 695 5365  
laboratori@valcambi.com





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