Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Effective Lifetimes of Atomic Layer Deposited Diffusion Barrier Films for Silver Artifacts[1] AMY MARQUARDT, University of Maryland, Department of Materials Science and Engineering, ERIC BREITUNG, E-Squared Art Conservation Science, GLENN GATES, TERRY WEISSER, The Walters Art Museum, GARY RUBLOFF, RAY PHANEUF, University of Maryland, Department of Materials Science and Engineering — We investigated using atomic layer deposition (ALD) to create dense, transparent oxide diffusion barrier coatings to reduce the tarnishing rate for silver art objects. An elevated H_2S aging chamber was used for accelerated aging to directly compare the effectiveness of 5-100nm Al_2O_3 ALD thin films and nitrocellulose coatings, the current technique for silver preservation, at reducing the tarnishing rate of silver while minimally affecting the visual appearance of the silver. Reflectance spectroscopy and an integrated sphere spectrophotometer were used to measure the thickness of the tarnish layer and indicate the lifetimes of the ALD and nitrocellulose coatings. Electrochemical impedance spectroscopy (EIS) was used to determine the porosity and average pore size of ALD films. Failure mechanisms for the two types of films were observed, the ALD films failing in defects or pinholes in the films and the nitrocellulose failing due to non-uniform in coating thickness. Thin Al_2O_3 ALD films were found to be more porous than thick ALD films, sufficient in protecting silver five times longer and effected the overall color change of the object less than micron thick nitrocellulose films.

[1]Work supported by the NSF under SCIART collaborative research grant DMR1041809

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Date submitted: 09 Nov 2012 Electronic form version 1.4