

# Understanding the structure and aging of Zwischgold

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Zwischgold (ZG) is a two-sided metal foil made by adhering a gold leaf over a silver leaf to present a gold surface while using less gold than normal gilding. It was historically applied to gilded artworks such as altars, sculptures and panel paintings as an economic substitute for gold foils [1]. ZG tends to oxidize quickly in air and therefore was usually coated with a protective varnish or used as a base for color glazing. However, after hundreds of years, some of these varnish layers have degraded and no longer provide proper protection to the artifacts. Artifacts applied with ZG are therefore commonly observed showing darkened surface regions (Fig. 1). ZG has received very little scientific analysis and so is poorly understood, which poses a problem for its conservation. The goal of our research is therefore to provide a scientific foundation for the assessment of future conservation/restoration treatments to aged Zwischgold artifacts.

We have successfully performed nanoscale measurements of the foil structure and aging mechanisms of ZG models without protective varnish applied. Here, we present observations of modern ZG and samples from historical artefacts, including details of foil thickness, the Au/Ag diffusion through different paths, the depletion of the Ag layer, as well as the formation and distribution of the corrosion products of ZG. Further, 3D visualization of the foil structure with high resolution has been achieved through ptychographic tomography based on ZG foils, models and historical ZG artefacts (Fig. 2).

[1] R.E. Straub, *Reclams Handbuch der künstlerischen Techniken, Bd. 1* (1984), p. 183-184.

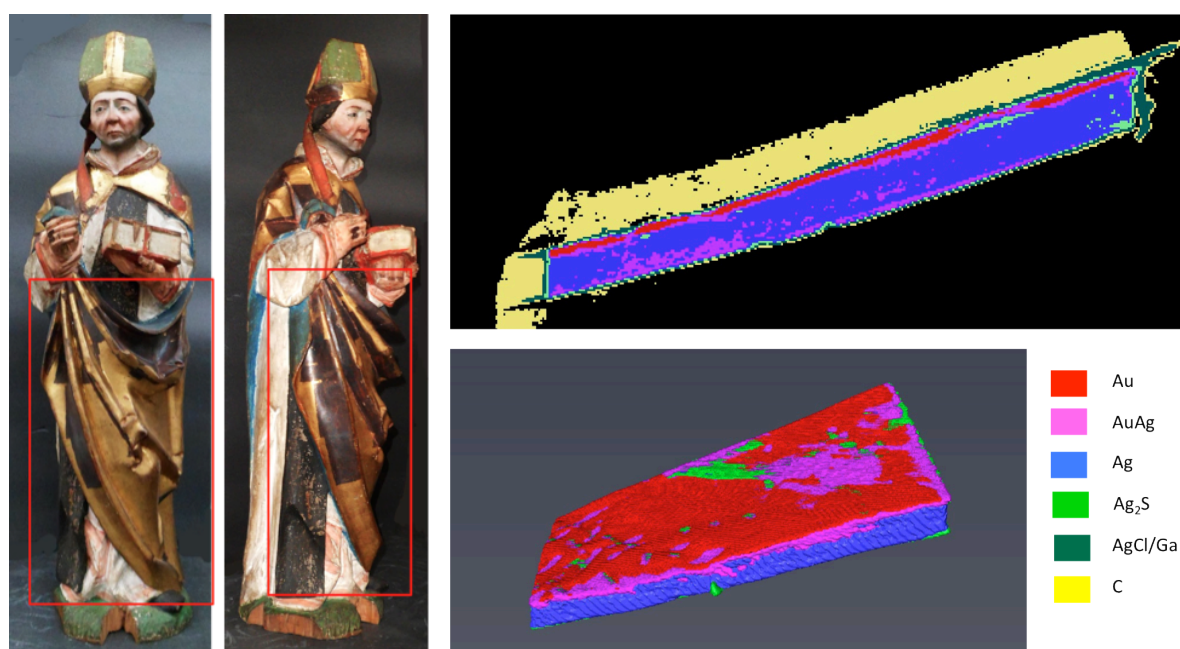


Fig. 1 (left): "Hl. Bischof", 15c, Basel Historical Museum. Corroded Zwischgold surface appears dark.

Fig. 2 (right): Ptychographic reconstruction of 10-year old Zwischgold foil; (lower) 3D image, (upper) 2D slice.