

## Terahertz Tomographic Imaging of Corrosion Products on Bronze Artifacts

Hui Zhang

School of Art and Archaeology, Zhejiang University

**Abstract:** The long-term exposure of bronze artifacts to various corrosive environments can lead to the formation of corrosion products that may cause significant damage to the artifacts. Therefore, accurately identifying the composition of these corrosion products, particularly harmful chloride-containing compounds and their distribution on the surface of the bronze, is crucial for the restoration and preventive conservation of these artifacts. However, some harmful corrosion products, such as basic copper chloride and cuprous chloride, are often covered by other corrosion layers, making them difficult to detect using traditional sampling methods, which also involve a degree of uncertainty. Consequently, obtaining both the composition and distribution of corrosion products, especially hidden chloride-containing harmful rust, in a non-destructive manner can more effectively aid in the precise protection and restoration of bronze artifacts. In this study, Terahertz Time-Domain Spectroscopy (TDS) was applied for the in-situ analysis and imaging of corrosion products on bronze artifacts. A terahertz spectral database for standard corrosion products on bronze was established through THz-TDS measurements, including their extinction coefficients, refractive indices, and fingerprint spectra. Simulated corroded copper samples were prepared using hydrochloric acid solution, and the thickness and composition of the corrosion layers were determined using the time-of-flight delay of the terahertz signal and the terahertz database. This technique was also successfully applied to the in-situ, non-destructive analysis of corrosion products on bronze artifacts unearthed from the Sanxingdui site in Sichuan Province.