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THz imaging of majolica tiles and biological attached marble fragments

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Devices exploiting waves in the frequency range from 0.1 THz to 10 THz (corresponding to a free-space wavelength ranging from 30 μm to 3 mm) deserve attention as diagnostic technologies for cultural heritage. THz waves are, indeed, non-ionizing radiations capable of penetrating into non-metallic materials, which are opaque to both visible and infrared waves, without implying long term risks to the molecular stability of the exposed objects and humans. Moreover, THz surveys involve low poewr probing waves, are performed without contact with the object and, thanks to the recent developments, which have allowed the commercialization of compact, flexible and portable systems, maybe performed in loco (i.e. in the place where the artworks are usually located). On the other hand, THz devices can be considered as the youngest among the sensing and imaging electromagnetic techniques and their actual potentialities in terms of characterization of artworks is an ongoing research activity.
As a contribution within this context, we have performed time of flight THz imaging [1,2] on ceramic and marble objects. In particular, we surveyed majolica tiles produced by Neapolitan ceramists in the 18th and 19th centuries with the aim to gather information on their structure, constructive technique and conservation state. Moreover, we investigated a Marmo di Candoglia fragment in order to characterize the biological attach affecting it.
All the surveys were carried out by using the Fiber-Coupled Terahertz Time Domain System (FICO) developed by Z-Omega and available at the Institute of Electromagnetic Sensing of the Environment (IREA). This system is equipped with fiber optic coupled transmitting and receiving probes and with an automatic positioning system enabling to scan a 150 mm x 150 mm area under a reflection measurement configuration.
Based on the obtained results we can state that the use of THz waves allows:
- the reconstruction of the object topography;
- the geometrical characterization of defects;
- the imaging of layered structures and inner features.
Specifically, as far as majolica tiles are concerned, we obtained cross-section images pointing out the presence of clay body, glaze and pigment layer. Moreover, pigment and glaze losses affecting the integrity of the surveyed objects were imaged, the depth extension of the losses was estimated and clay body inhomogeneities were observed. Finally, by taking into account the retrieved features of the topography and the spatial distribution of the detected clay body inhomogeneities, hypothesis on the clay shaping modalities were inferred. In addition, with reference to the marble fragment, the zones mainly affected by the biological attach were identified.
A detailed presentation of the surveys and obtained results will be provided at the conferences.

REFERENCES

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