

## ENERGY DISPERSIVE X-RAY FLUORESCENCE ANALYSIS OF THE “GATES OF PARADISE” IN THE BAPTISTRY OF FLORENCE

**G. Buccolieri<sup>1</sup>, R. Cesareo<sup>2</sup>, A. Buccolieri<sup>5</sup>, S. Ridolfi<sup>3</sup>, A.M. Giusti<sup>4</sup> e A. Castellano<sup>1</sup>**

<sup>1</sup> Dipartimento di Matematica e Fisica, Università del Salento, Lecce, Italy,  
e-mail: giovanni.buccolieri@unisalento.it

<sup>2</sup> Struttura Dipartimentale di Matematica e Fisica, Università di Sassari, Italy

<sup>3</sup> Ars Mensurae, Rome, Italy

<sup>4</sup> Opificio delle Pietre Dure, Firenze, Italy

<sup>5</sup> Dipartimento di Scienze e Tecnologie Biologiche ed Ambientali, Università del Salento, Lecce, Italy

The east door of the Baptistry of Florence, also became known as *Gates of Paradise* (Figure 1) was done by Lorenzo Ghiberti between 1426 to 1452 [1]. It is composed of ten panels made on gilt bronze. The gilding was produced with an amalgam of gold.



**Figure 1** - Baptistry of Saint John in Florence (left) and east door of the Baptistry known as “Gates of Paradise” (right)

Today, models of the doors hang on the Baptistry, while the originals are on display at the *Museo dell’Opera del Duomo* in Florence.

Previous analysis of the bronze alloy showed that it is mainly composed of copper (more than 90 %) and other elements such as tin, lead, zinc, silver and antimony [2-3]. However, nothing is known about the gilding composition and thickness.

A portable energy-dispersive X-ray fluorescence (EDXRF) equipments was transferred in 2009 in Florence in the *Opificio delle Pietre Dure* where the panels of the Door were under restoration.

In particular, the panel Abraham (panel n. 4 or the second panel to the right starting from the top) was analyzed in many areas, both to analyze again the bronze composition, and the gilding composition and thickness. This last parameter was determined by using the  $\text{Cu}(K_{\alpha}/K_{\beta})$ -ratios, which depend on the gold-thickness.

## References

- [1] G. Brunetti, 1966, *Ghiberti*, Sansoni Editore, Firenze.
- [2] G. Alessandrini, G. Dassù, P. Pedeferra, G. Re, 1979, *On the conservation of the Baptistery door in Florence*, *Studies in Conservation*, Vol. 24, No. 3, 108-124.
- [3] M. Marabelli, R. Cesareo, 1976, *Analisi XRF di antiche porte italiane in leghe di rame*, Congresso internazionale Applicazione dei metodi nucleari nel campo delle opere d'arte: Roma-Venezia, 24-29 Maggio 1973, Pubblicazione Roma: Accademia nazionale dei Lincei.