ITALIAN MONEY TESTED FOR FORGERY BY MÖSSBAUER SPECTROSCOPY

I. Ortalli, G. Pedrazzi

(Istituto di Scienze Fisiche, University of Parma, 43100 Parma, Italy)

Jiang Keyu (蒋可玉)

(East China Normal University, Shanghai 200062, China)

Zhang Xiufang* (张秀芳)

(Tsinghua University, Beijing 100084, China)

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ABSTRACT

Italian money has been investigated by Mössbauer spectroscopy. The results indicated that the spectrum of a 10000 lire bank-note consisted of three magnetic sextets and two quadrupole doublets, the spectrum of a 50000 lire note consisted of two Zeeman sextets, but in the "false" money there are two quadrupole doublets only.

Keywords: Mössbauer spectroscopy Forgery Bank note

Iron is an abundant element in the Earth. It plays important roles in biological and chemical systems and is present in natural and man-made materials. Mössbauer spectroscopy, with its ability to distinguish oxidation states as well as magnetic properties, is one of the most suitable techniques to study iron compounds. Among the wide range of possible applications, it has been used to investigate ancient findings, like potteries or paintings. In 1974, for example, B.Keisch[1] reported a study on fine arts materials using Mössbauer spectroscopy. The study included a small number of significant examples where Mössbauer spectroscopy solved dubious authenticity. In 1991 V.Rusanov *et al.*[2] showed that Mössbauer spectroscopy could be successfully used for checking dollar bank-notes authenticity.

Following these indications we decided to investigate Italian money and in particular the 10000 lire and the 50000 lire notes. These are by far the most common bank notes in Italy, and for the same reason, the ones preferred by forgers. The colour of the bills is blue for the former and dark red for the latter, respectively (Fig.1a and Fig.2a).

A single bank note was used in each measurement. In order to obtain a suitable

* To whom correspondence should be addressed

sample for Mössbauer measurements the bank notes were folded until an area of about 4 cm^2 has been obtained. The experiments were made in transmission geometry with a constant acceleration spectrometer. The spectra were all recorded at room temperature using a $^{57}Co/Rh$ source with an activity of about 1.85 GBq. The data were fitted using a least squares fitting program with combinations of six and two lorentzian peaks.

Fig.1a Picture of an italian 10000 lire bank note

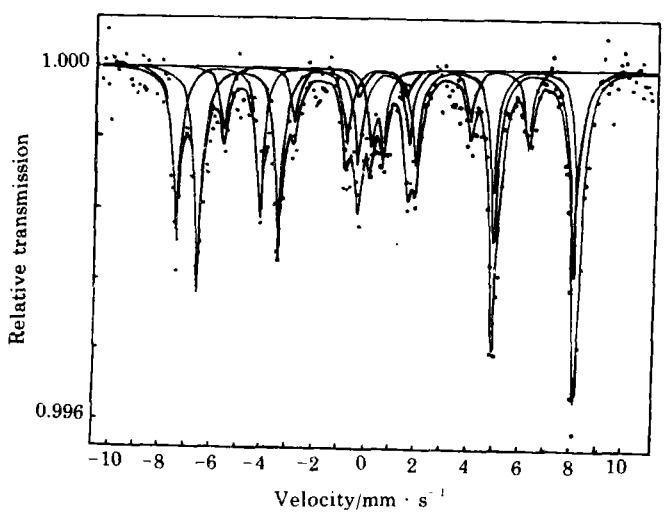

Fig.1b Mössbauer spectrum of an italian 10000 lire bank note

Fig.1 shows the picture of the Italian 10000 bank-note and the related Mössbauer spectrum. This spectrum has been fitted with three magnetic sextets and two quadrupole doublets. Up to now, unfortunately, we have not been able to find a false 10000 lire bank-note. We have been more lucky with the 50000 lire.

Fig.2 shows a) the picture of an Italian 50000 note, b) the Mössbauer spectrum of an authentic 50000 note and c) the spectrum of a false 50000 note. The differences are evident: in the spectrum of the 'true' money we find the presence of two Zeeman

sextets with well characterised magnetic fields, while in the 'false'money there are two quadrupole doublets only.

Fig.2a Picture of an italian 50000 lire bank note

From the values of Mössbauer parameters (Isomer shift, Quadrupole splitting, Magnetic splitting) it is possible to identify the different iron states in the dyes, and in some cases, is possible to identify the dye itself. However, we prefer to limit our presentation to qualitative aspects only. We do not report in detail the numerical values of the Mössbauer parameters because, even if very unlikely, we do not want to give hints about which dyes may sort a more veritable effect on false money. We hope the readers will understand our point of view.

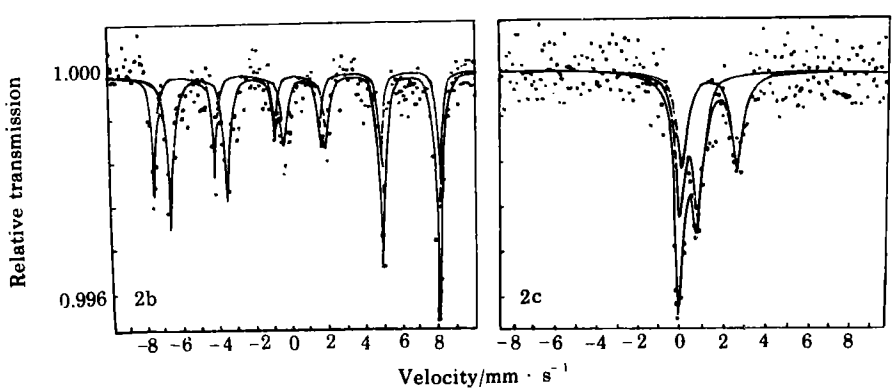

Fig.2b,2c Mössbauer spectrum of an authentic (b) and a false (c) Italian 50000 lire bank note

REFERENCES

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