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PIXE TECHNIQUE APPLIED TO ALMEIDA JÚNIOR MATERIALS

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ABSTRACT

The Institute of Physics University of São Paulo in collaboration with the Pinacoteca do Estado of the State of São Paulo has a project to develop a data bank with information about the elementary composition of pigments of paintings and materials of its collection. The project are beginning with some materials of the Almeida Júnior painter (palette, paint box and paint tubes). Twenty-three spots of the palette were chosen with predominance to determined colors, and also of the paint tubes that were present in the paint box. The PIXE analysis of the spectra enabled to conclude that the red colour. The obtained results also allow to conclude that, for the analyzed tubes of white and red colors, the pigment present in the palette is the same of the paint tubes that were in the box: lead white and vermillion, respectively.

1. INTRODUCTION

The Material Ion Beam Analysis Laboratory (Laboratório de Análise de Materiais por Feixes Iônicos – LAMFI) of the Institute of Physics University of São Paulo has installed an external pront beam device for PIXE analysis[1]. This structure is being used in the non-destructive analysis of ceramics, artifacts, paintings and biological tissues, which are not compatible with the high vacuum of the PIXE chamber[2].

The composition of paints found in a palette, tubes, paint box and cleaning cloth were analyzed of a Brazilian painter Almeida Júnior (1850-1899). that belong to the Brazilian painter named Almeida Júnior (1850-1899). These materials (shown in figs. 1, 2 and 3) were lent by the Pinacoteca of State of São Paulo. To identify the chemical elements corresponding to different colour on the palette twenty-three spots were selected (see fig. 1).

Green, blue and red smudges in the cleaning cloth and blue smudge in the pint box were analyzed. In the box it was analyzed a blue paint smudge.

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Figure 1. Palette with characteristic points chosen for analysis.

Figure 2. Cleaning cloth.

Figure 3. Paint box of wood with metallic division inside.

2. RESULTS

All spectra shown in this work are normalized to the proton induced fluorescence of the K line of Ar which is present in air. In fig. 4 are shown the spectra corresponding to the white colour of point 3 and the white from the paint tube. Similarly in fig. 5 we have the spectra

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corresponding to the red of the point 10 and the red tube. The two spectra present in fig. 4 are similar except for a visible difference in the Ca, Ti and Fe peaks. In the other hand, fig. 5 shows large difference between the two spectra. This difference is due to the fact that a thin layer of red paint over the tube was analyzed. When irradiated, protons penetrated the paint layer hitting the casing of the tube giving a typical spectra of metal elements which it is made together with the elements of the red pigment. In the other hand the white tube had a very thick layer of white paint shielding it from the protons. An hypothesis for the presence of Ca, Ti and some Fe in both cases can be due to the contact of the tubes with the inner metallic case inside the paint box, as you can see in fig. 3.

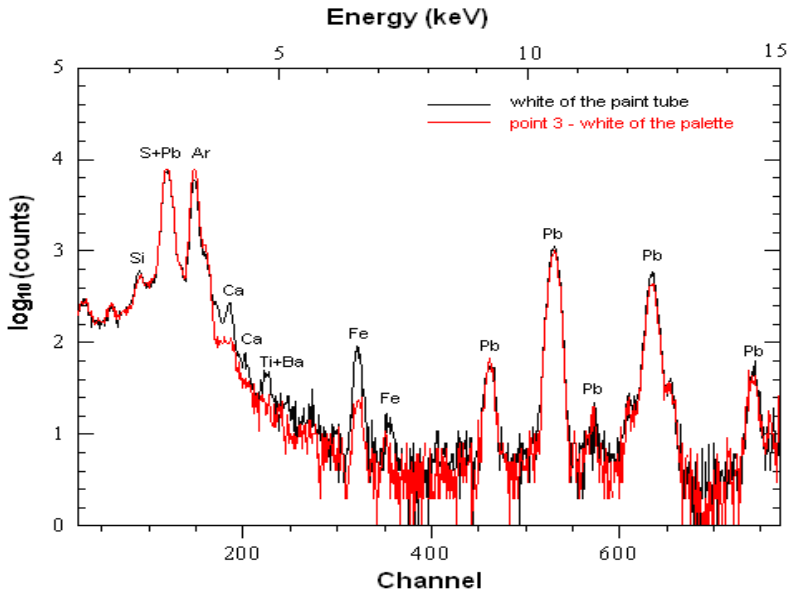

Figure 4. Spectra of the paint tube and of point 3 (white) of the palette.

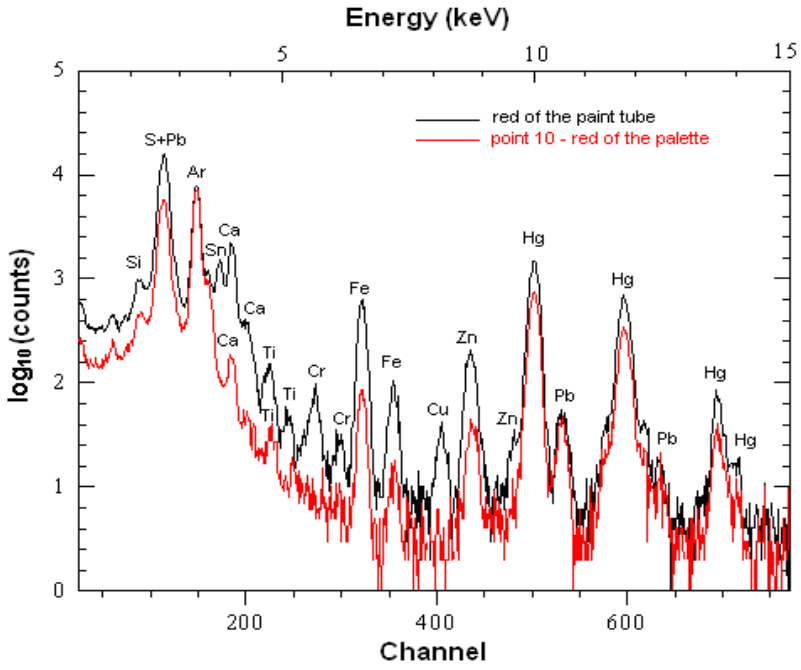

Figure 5. Spectra of red of the paint tube and point 10 (red) of the palette.

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In the red paint spectra (fig. 5) the similarities are fewer but the differences besides Ca, Ti and some Fe are mainly associated with the elements present in casing tube, like the Sn, Cu, Ba and Cr (the paints were analyzed without being removed from the tubes). Some quantity of Fe, Zn and Pb can be also associated to the casing tube. Cr appear almost only in red paint on the tube. In the figure 6 it is possible to see the comparison of the spectra of the red paint on the tube with one of the saving of the same tube. In these spectra it is curious the quantity of Zn and Fe that showed up in the paint and did not in the casing and the latter has almost no Cr. This element is present in various pigments of yellow and green colours [3], which can be a mixture of some of them with the red pigment vermellion.

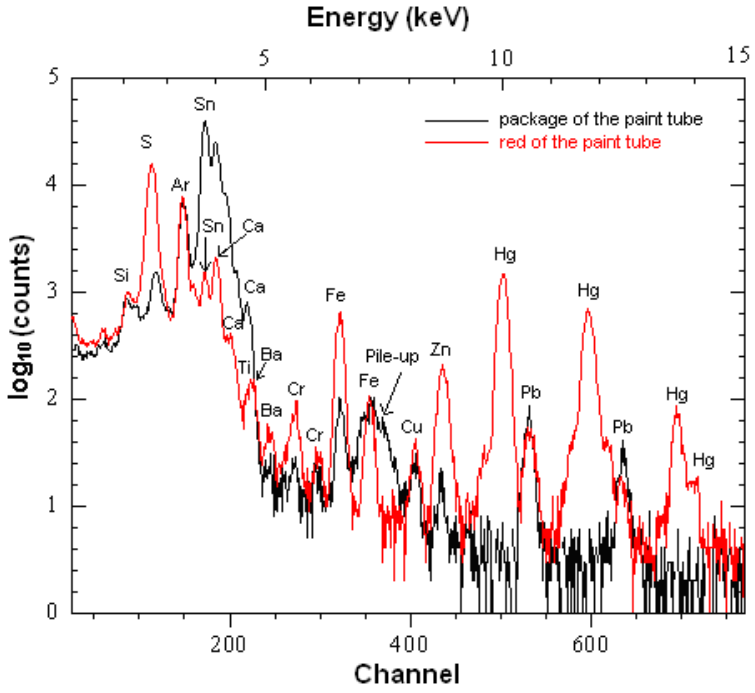

Figure 6: Spectra of red of paint tube and of the casing (metallic) of the tube.

The colours studied, white and red, due to the large presence of Pb and Hg, show that the main pigment component is Lead White and Vermellion, respectively. The other elements came probably from the casing tube and some mixtures of other pigments, for exemple: Chrome Yellow and Chrome Green.

The data analysis of the results are underway to characterize the pigments used by the painter Almeida Júnior.

3. CONCLUSIONS

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The PIXE technique can be used in the elemental composition analysis of a pigment in a non-destructive manner. Due to the nature of the analyzed material and of peculiarities of the PIXE technique, the analysis realized in this case is semi-quantitative. The analysis of the obtained spectra allowed to conclude that the red coulour present in the palette and in the tubes is the HgS (Vermillion) (red pigment utilized since the antiquity until the present). The white one are the $2PbCO_3 \cdot Pb(OH)_2$ (Lead White).

The obtained results also allowed to conclude that for the analyzed tubes from white and red colors, the pigments of the same colours present in the palette are the same which are present in the paint tubes.

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