

SEM/EDS ANALYSIS OF GUNSHOT RESIDUES FROM BRAZILIAN LEAD FREE AMMUNITION. André Luiz Pinto(1), André Guzman Oliveira(1), Andrea Martiny(2), Andrea Porto-Carreiro Campos(3), Ladário da Silva (4). (1) Instituto Militar de Engenharia, Rio de Janeiro, RJ; (2) Fundação Oswaldo Cruz, Salvador, BA; (3) Instituto de Criminalística Carlos Éboli, Rio de Janeiro, RJ; (4) Escola Naval, Marinha do Brasil, Rio de Janeiro, RJ; E-mail: pinto@ime.eb.br

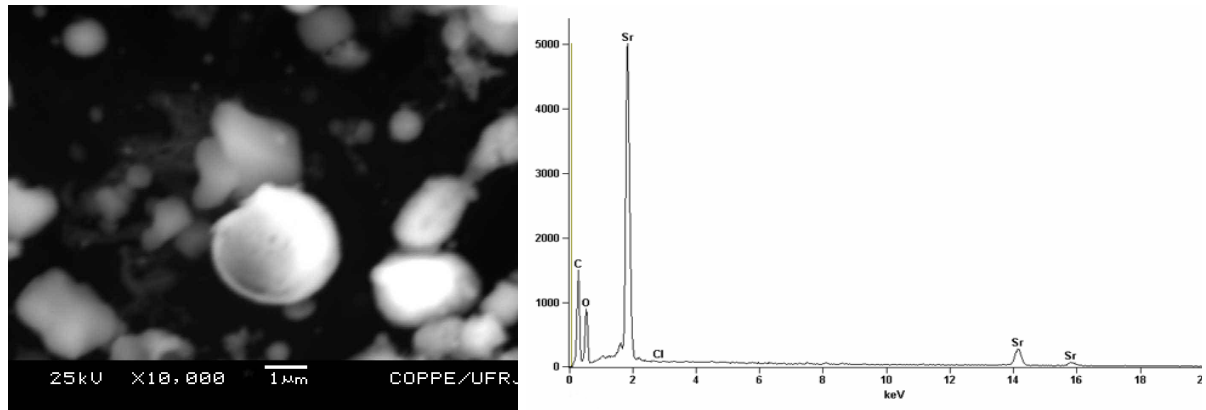
During the investigation into suspected use of firearms, detection and identification of characteristic particles from the firearms discharge provide valuable investigative information. Since earlier works where partially burnt nitro-compounds were sought, the methods used for detection of gunshot residues (GSRs) went through great improvement. It is now common sense that residues from the primer should be investigated since they are often composed of Pb, Ba and Sb derived from lead styphnate, barium nitrate and antimony sulphide respectively. Different chemical analytical methods are suitable for this kind of analysis, but the presence of these three elements in a variety of routinely occupational tasks has led to the use of the scanning electron microscope (SEM) together with energy dispersive spectroscopy (EDS) as the preferred method of identification for the presence of GSR [1]. The use of SEM/EDS is so widespread over the forensic science community that a ASTM standard has even been established [2]. Nevertheless, the increased concern about range owners and dedicated shooters' health - often exposed to a heavy metal-rich airborne in indoor spaces used for fire practicing - has prompted the ammunition producers to develop a new generation of lead free ammunition, currently available all over the world. This work seeks to establish the characteristic GSR elements present in the Brazilian lead free ammunition. Lead free ammunition commercialized by Companhia Brasileira de Cartuchos (CBC) was used throughout out this study. A very limited amount of first generation lead free ammunition was available for the tests, but there were no restrictions for the second generation lead free ammunition, which is currently on the market under the name CBC Clean Range. Standard ammunition was also analyzed in order to compare the GSRs found. Initially, cartridges from the different kinds of ammunition (9mm, .380 AUTO and .38 SPL) were dismounted and their primers were manually ignited. The residues from the primer were directly collected with double face conductive carbon tape onto glass slides or aluminum stubs. The next step consisted of retrieving GSR from the shooters' hands. Special care was taken with extensive cleaning of the guns and shooters' hands in order to avoid lead contamination from previous shots. Residues were collected as described above in an outdoor shooting range and samples were analyzed in a Jeol JSM-6460LV SEM (COPPE/UFRJ) equipped with a Thermo SIX 1 EDS accessory. A working distance of 10mm, an accelerating voltage of 25 keV and manual search were used in all analysis. Fig. 1 shows GSR data from the first generation CBC lead free ammunition (produced until 2002) where a spherical particle containing Sr could be observed. Fig. 2 shows primer residues from the second generation CBC lead free ammunition (produced after 2002) where particles containing Al, Si, K and Ca could be observed. It is worth noting that the results are in complete agreement with the compositions expected [3] for the primer which are diazole, tetrazene, strontium nitrate and powder for the first generation CBC lead free ammunition and diazole, tetrazene, nitrocelulosis, potassium nitrate, aluminum and glass for the second generation CBC lead free ammunition. We can conclude that identification of GSR derived from lead-free ammunition in suspects' hands will be a difficult task without the addition of a distinct metallic marker in the primer composition.

ACKNOWLEDGEMENTS

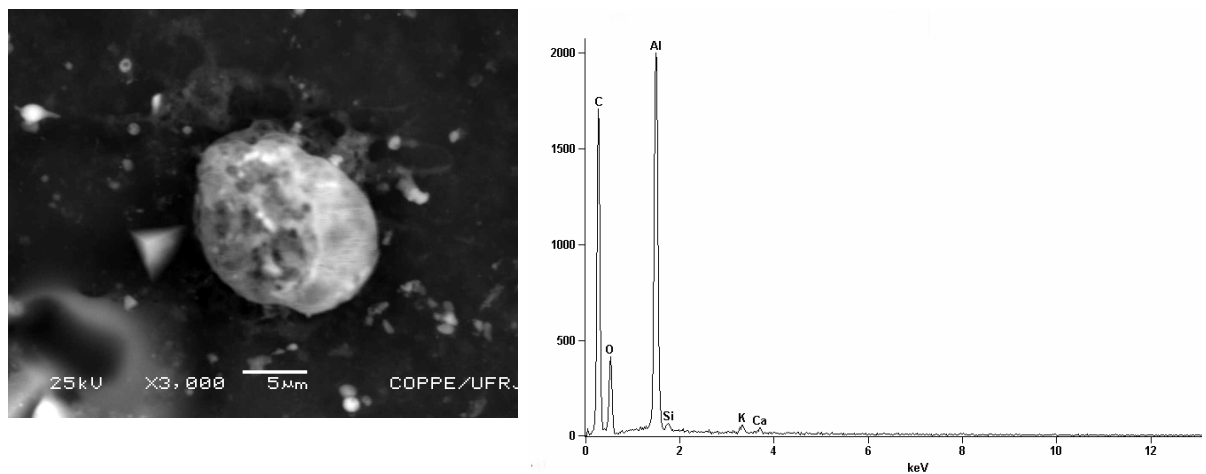
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Figures 1: GSR from a 9 mm CBC Clean Range discharge and EDS spectrum from the previous particle.



Figures 2: Particle resulting from the detonation of the primer of a 9 mm CBC Clean Range ammunition and its EDS spectrum.