

## X-Ray Microanalysis of Art Glass Surfaces

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The Studio Glass Movement began in 1962 when Harvey Littleton began exploring the idea of creating art from molten glass in a garage on the grounds of the Toledo Museum of Art in Toledo, OH. Since that time the world of art glass has expanded to include a range of items from large scale sculpture to hand-crafted jewelry. Glass formulations have evolved to bring a host of new colors into artists' palettes and come from both large and small scale manufacturers. Torch technology has also advanced to the point of bringing glass art out of the large scale 'hot shop' and into the studios and homes of hobbyists. This expansion of glass art production has introduced both the excitement of the creative process and the hazards associated with such work to many people who often are not familiar with many aspects of the latter. In general, the colorants in glass are metallic compounds (oxides, chlorides, etc.), some of which may be hazardous to both the glass worker and the consumer. This project began as a study of metallic surfaces on glass beads used in a program for providing emotional and psychological support for children in treatment for cancer and other life-threatening illnesses (Beads of Courage, Inc.).

The commonly used 'reduction surface' technique in art glass creates a metallic 'luster' surface on the glass. Reduction surfaces can be quite colorful and are popular in art glass jewelry. It is this type of surface which can be of concern to both the artist and end user of the product. As a rule these effects are produced when a glass with a high metal content is exposed to a flame with an excess fuel to oxygen ratio (aka reduction flame). This flame type tends to remove oxygen from metal compounds and leave pure metal on the surface. Problems come about in two areas: (1) release of vaporized metal into the workspace of the artist and (2) the chemical nature of the metallic surface which may come into contact with the wearer's skin. A number of different heavy metals are used for this type of art glass used in jewelry, some of which are both toxic and regulated by government agencies. Glass color names may be misleading when it comes to disclosure of the types of metals involved. Microanalysis of these popular glasses and dissemination of the results can be of critical importance for both worker safety and consumer protection. While immediate toxicity to the consumer is practically unknown, at least one metal commonly found in reduction surfaces (Pb) is controlled by the Consumer Products Safety Commission and may present complex and expensive legal issues to distributors and consumers of finished art glass, especially if the objects are to be handled by children (1). Gold appearing surfaces are often assumed to be metallic gold, silver surfaces silver, etc. Analysis of these surfaces shows that visual color and color name may, in some instances, be misleading.

Samples of 'reduction' glass from different manufacturers were purchased on the commercial market. Each was then flameworked to produce the metallic reduction surface, and analyzed to determine the elements present. The samples were examined in a LEO 1450vp scanning electron microscope operating at kV20 and were further analyzed by Energy Dispersive X-ray Microanalysis (EDS) using a Rontec X-Flash X-ray microanalysis system.

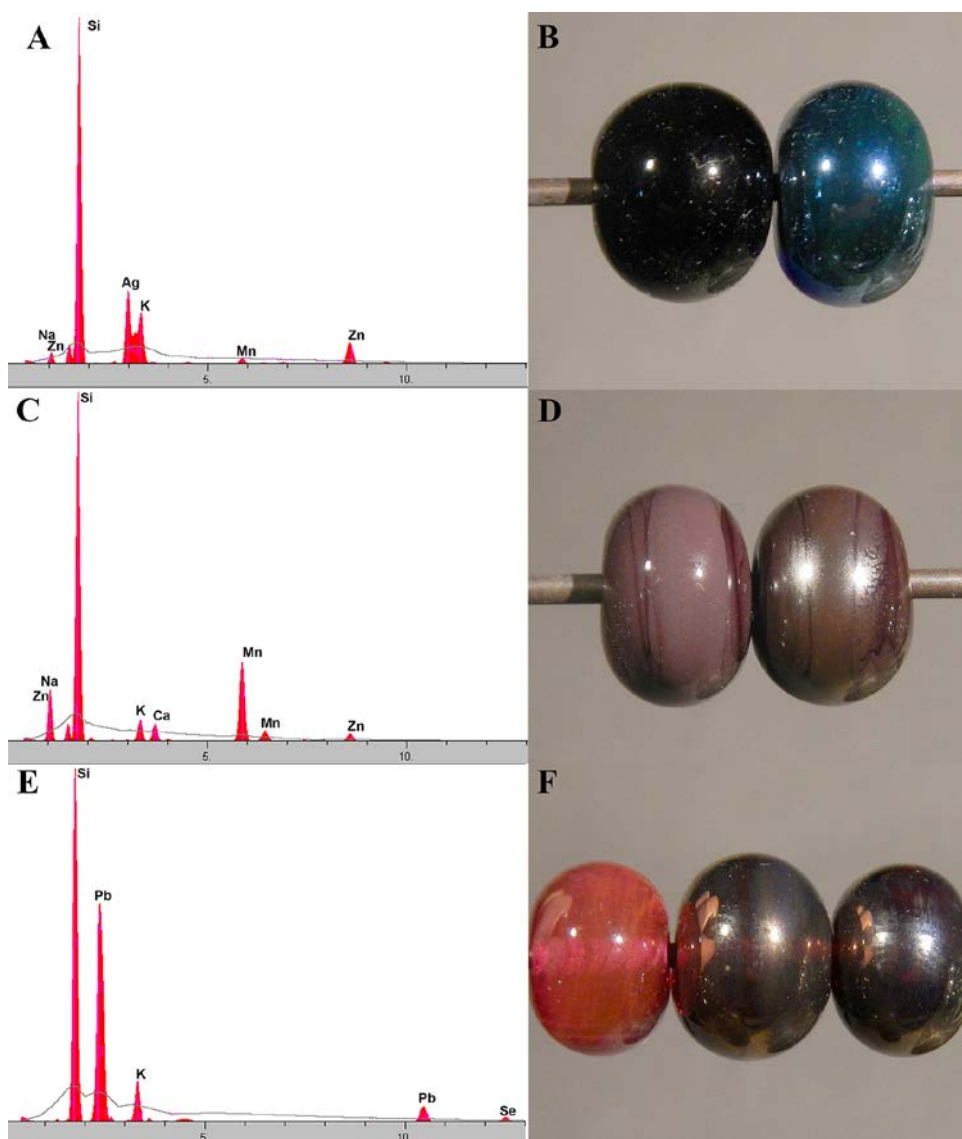
Results showed that while many surfaces were very similar in appearance the chemical composition on the surface could be quite different. Examples of these surfaces are seen in Figure 1. One heavy

metal in particular, Pb, is not considered safe for human contact and has been banned from use in any materials which may be contacted by children under 12.

Beads of Courage, Inc. routinely uses artist made glass beads in their support programs for children in treatment for cancer and other serious illnesses and expressed concerns related to the safety of metallic surface beads and the ability of their staff to discern difference glass types. Based on these results Beads of Courage, Inc., made the decision to remove all metallic surface glass beads from circulation in their programs.

#### References

1. Consumer Product Safety Improvement Act of 2008, <http://www.cpsc.gov/cpsia.Pdf>



**Figure 1.** **A.** Spectrum from ‘Psyche’ indicating the presence of Ag on the reduction surface. **B.** Psyche in neutral and reduced form. **C.** Spectrum of ‘Silver Plum’ showing the presence of Mn. **D.** Neutral vs. reduced Silver Plum showing the reflective silver-appearing Mn surface. **E.** Spectrum from Gold Ruby showing the presence of Pb and trace amounts of Se. **F.** Neutral Ruby Gold glass compared to the gold-to-silver reduction surface.