

Introduction

- The Black Hills of South Dakota is rich in Native American culture. A substantial part of Native American culture is arts and crafts. Artwork and artifacts are often counterfeited or misrepresented.
- For Native Americans and Alaskans, art is not only part of who they are as a people but it is also a livelihood.
- The Native American art market is estimated as a one billion dollar a year industry. According to the First People Fund, an estimated 30-percent of Native peoples are artists.

Objectives

The goal of this research is to incorporate security printing and forensic analysis as methods to authenticate Native American artwork and artifacts.

Employ non-destructive testing methods to analyze a Native American artifact, a quiver [Figure 1](#), [Figure 2](#), [Figure 3](#)., from the Heritage Center at the Red Cloud Indian School collection. Conduct a cultural investigation to determine the importance of the quiver.

Test the feasibility of nanoparticle ink on substrates found in contemporary art and historical objects was tested.

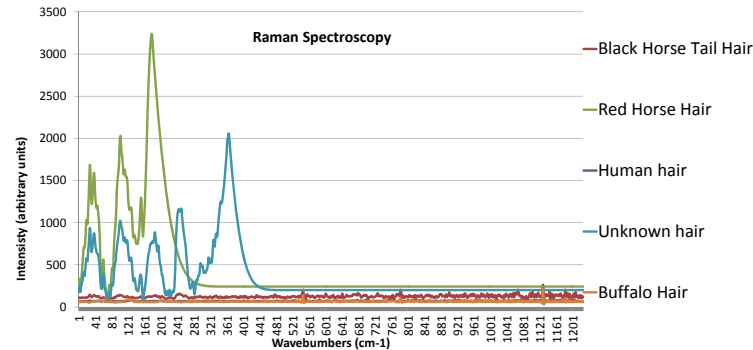


[Figure 1,2,3](#). Quiver provided by Heritage Center at the Red Cloud Indian School.

Procedures

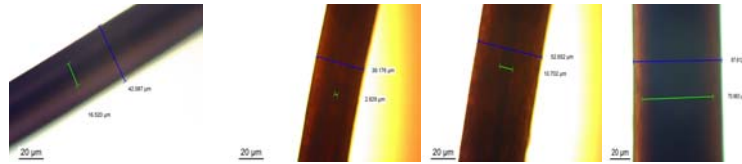
- Acquire quiver from Red Cloud Collection
- Conduct historical/cultural investigation (analysis) to determine cultural relevance
- Conduct Forensic Analysis Utilizing
 - Leica DM2 2500 p polarizing microscope
 - X-Ray Fluorimeter
 - Raman Spectrometer
- Apply security printing technology
 - Green up -conversion fluorescence ink with 2 wt% of upconverting nanoparticles (β -NaYF₄: 17% Yb³⁺, 3% Er³⁺), 1 wt% of PMMA in solvent mixture of 90:10 v/v toluene/methyl benzoate
 - Optomec Aerosol 3dJet Printer

Results



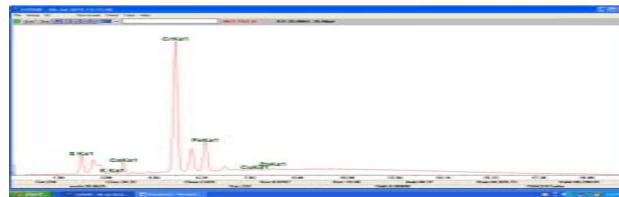
Raman Spectroscopy

Results show the unknown hair does not have a Raman signature similar to any of the known hair samples. Shown in [Figure 12](#).



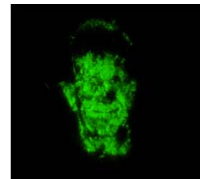
Hair Analysis

The unknown hair sample was not microscopically similar to any of the known hair samples. The comparison can be seen in [Figure 13](#)., [Figure 14](#)., [Figure 15](#)., [Figure 16](#).



X-Ray Fluorescence

In [Figure 4](#). The results of the X-Ray Fluorescence testing confirmed the use of chromium which indicates chromium tanning.



[Figure 5](#). QR elk hide printed on using Up converting nano particle Inks.



[Figure 6](#). QR code printed on turkey Feather using up converting nano particle Inks.



[Figure 7](#). QR printed on using deer hide up converting nano particle Inks.

Security Printing

Security printing was applied using up converting nano particle inks shown in [Figure 5](#). Image on Elk hide, [Figure 6](#). QR code Turkey Feather, [Figure 7](#). QR code on deer Hide.

Conclusion

- Based on the present analysis the quiver is consistent with the methods of manufacturing and cultural relevance of a traditional Native Americans.
- Historical investigation indicated the quiver was made near the beginning of the twentieth century.
- Chromium in the tanning process makes it more likely the quiver was made during the mid-twentieth century.
- Security-printing technology can be used to enhance the security of the Native American artwork and artifacts was demonstrated.

Broader Impact

- Today, an estimated 30 % of Native peoples are practicing artists(First Peoples Fund, 2013).
- "Over 80% of the 1.5 Billion in faux Native American products (baskets, pottery, jewelry) are fabricated by non natives and imported into the U.S. from Asia (AIACA 2010 Marketing Seminar)" (M'Kloskey, 2013).
- Application of security printing and anti counterfeiting technology will revolutionize the Native American art market.
- Security printing will add level of security that is not available to artist; this will act as deterrent to counterfeiters.



Examples of contemporary art. [Figure 8](#) ., [Figure 9](#) ., [Figure 10](#). [Figure 11](#).

Acknowledgments

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