Evaluation Form – Technical Background Review

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_____ / 30 Technical Content

- Current state-of-the-art and commercial products
- Underlying technology
- Implementation of the technology
- Overall quality of the technical summary

_____ / 30 Use of Technical Reference Sources

- Appropriate number of sources (at least six)
- Sufficient number of source types (at least four)
- Quality of the sources
- Appropriate citations in body of text
- Reference list in proper format

_____ / 40 Effectiveness of Writing, Organization, and Development of Content

- Introductory paragraph
- Clear flow of information
- Organization
- Grammar, spelling, punctuation
- Style, readability, audience appropriateness, conformance to standards

_____ / 100 Total - Technical Review Paper

A Look Into the Material World With Self Defense Weapons

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1. Introduction

Compared to many areas of the world, North America is considered a place where women have equal rights and status. There are no formal prohibitions against women's autonomous functioning or restrictions on access to jobs or education. Despite this, violence against women is epidemic in North America, including homicide, assault, domestic violence, incest and child abuse, rape, and elder abuse [1]. In most cases, the violence goes undetected and gets dismissed when brought to the police or the court. In North America, the concept of violence has expanded to include categories such as sexual harassment, breaches of fiduciary trust, and stalking. It is impossible to end all forms of violence, but it is possible to help prevent more attacks from occurring.

2. Existing Products

With all the violence against women going unchecked, it is apparent that it is up to each woman to equip herself with tools and weapons to guard off these possibilities. As such, the weapon has to fit specific criteria to be helpful against such attacks.

2.1. Material Breakdown

Mechanical properties (elasticity, hardness, ductility, viscosity, etc.) characterize the ability of a material to resist deformation and fracture. Surface hardening of steel is essential for various fields of application. To test the steel's mechanical properties, an approach would be to "modify the surface or near-surface layer of the steel itself without special building up or enlarging the size of a workpiece" [2]. This method allows a more selective and localized hardening (heating and quenching, selective nitriding, titanium-carbon diffusion, ion implantation, laser hardening, etc.) [2], [3]. When choosing a material, it is imperative to know what materials to allocate to different applications. For jewelry, there are many metals but the most common is 316L Stainless Steel

(SS). 316L SS is very durable, corrosion-resistant, and effortlessly polished. The maintenance and long-wear certainly attract many jewelers to this metal. While a great choice, it is also relevant that the composition of the 316L SS must not have too much Nickel in it. According to Catlogix, more nickel can sometimes cause irritation and an allergic reaction on human skin. Stainless steel 316 contains 10-13% nickel and according to the EU directives on Nickel ion migration, 316L SS has to leach less than 0.2 µg/cm2/week for post assemblies. This could still be too much for people with nickel allergies or who are hypersensitive [4].

After having picked the metal, calculations of its quasistatic hardness is measured by using Vickers and Berkovich indenters, respectively, as the arithmetic mean by following formulas:

$$H_{miV} = 2P/d^2 \tag{1}$$

$$H_{miB} = 1.74P/l^2 \tag{2}$$

where P is the load on the indenter, d is the diagonal of the Vickers imprint, l is the triangle height of the Berkovich indentation projection [2].

With the formulas and experiments set up, it shows that a decrease in hardness accompanies an increase in the indenter load. The formation of a fine-grained structure was detected both in the indentation and in the scratch methods. This indicates that at low loads (P =10, 20 mN) on the metal, deformation around the load impact zone propagates around a small area. Higher loads (P = 20-2000mN) can cause a strain on the metal, leading to microscopic scratches and a more significant impact area.

Grabco found that the steps inside the scratches represent the traces of the indenter edges and serve as proof of the jump-like (stick-slip) nature of the scratch formation [2], [3]. . As a result, while under a concentrated load, the 316L SS performed well and showed it could withstand several types of concentrated loads.

The data obtained in this work expand the understanding of the deformation mechanisms of the austenitic steel AISI 316L, which can be useful for its practical application.

2.2. Competitors

Knowing more about the common and specific features of 316L SS, it is evident that using such metal will not only withstand rusting and long wear, but maintain its hardness and overall condition. The company Defender Rings [5], has already taken advantage of such metal. Defender Rings has produced a wearable ring with a blade underneath a protection bead. The band and blade weapon are made of 316L Stainless Steel, again known for its strength, durability, corrosion resistance, and hypoallergenic properties while the ring tops are made of different materials including 925

Sterling Silver, 316L Stainless Steel, 14K Gold, Rose Gold, and Colored Enamels. While the design provides for a use for strength and durability, the ring top is still mechanical and requires the user to manually remove it for use.

Another competitor, invisaWear [6], has a different functionality than from Defender Rings. invisaWear acts as a bracelet that when pressed a certain number of times, contacts the authorities and notifies 5 of the pre-defined emergency contacts. The invisaWear charm is made out of brass. The gold charms are plated in 14k gold and the silver invisaWears are plated in Rhodium. The backside of the invisaWear charm is plastic so that it can be easily pressed. While convenient, it not made out of a material that is durable enough to withstand an impact.

3. Electrical Properties

As it is impertinent to have a material that conducts electricity well, 316SS has an Electrical Resistivity 7.4e-005 ohm-cm at 20ºC [7]. The best metal conductor, such as hard-drawn copper, has an Electrical Resistivity of 1.77e-06 ohm-cm. The 316SS has relatively high conductivities and low resistivities which makes it a conductor.

On the market, ADVANCED TASERS currently are made up of the following:

- Recycled plastic grocery bags.
- Sonic welded, molded, high impact polymer.
- Machined alloy.
- Lightweight metal.[8]

For the product, it is imperative to continue to gather more research on the best conductive materials for the casing and the inside of the ring. Able to conduct and withstand most impacts, 316L SS is the best option.

4. Conclusions

Studies have shown that various testing methods (submicro-, microindentation and micro-scratching) create similar patterns of plastic deformation in thin surface layers 316SS material. With the inherent stick-slip nature of the scratching process, it is found that load growth leads to a decrease in hardness under submicro-, microindentation and microscratching for all applied methods [2]. This method affects the mechanical characteristics that should be taken into account when considering the practical purpose of the AISI 316L austenitic steel products in self defense weapons. Considering a combative, long use, and resistant application of the product, 316SS is not only a decent conductor, able to carry the charge of the stun gun, it is able to withstand a hard impact by a possible physical altercation.

References

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