Gunshot Residue Nanoparticle Spray Pattern Analysis Using an Atomic Force Microscope

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Abstract:

The main objective of this research is to discover gunshot residue nanoparticle spray patterns that are specific to a particular barrel length of a firearm. This research would enable investigators to determine the barrel length of a specific caliber gun used in a crime and ultimately narrow down the possible light microscope. One of the primary reasons that the atomic force microscope is the best microscope to analyze GSR nanoparticle spatter is because the three

Introduction:

comes in contact with a surface, a particular nanoparticle pattern is formed. A nanoparticle is an ultrafine particle sized between 100 and 1 nanometers. This pattern can alter in shape, distribution, uniformity, etc.

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In order to examine nanoparticles, an investigator might use a scanning electron microscope, (SEM), or an atomic force microscope, (AFM). An SEM recognizes and reads various types of metals in a sample and can be very costly. The SEM also requires meticulous presetup steps that need to be followed. Since it is established that what is being analyzed is in fact GSR, the SEM would not be informative in this aspect of the research. Since ammunition is composed of various chemicals, it is not guaranteed that every batch is exact in its chemical composition. An SEM focuses mainly on the chemical makeup of a sample and since our sample is GSR and is chemically inconsistent in its small probe, usually less than 10 microns long, that passes over a surface and moves up and down every time it passes over a particle. The vertical heights of the probe are then calculated with a laser and this generates a 3 dimensional image of the sample. This image can be magnified up to 100,000,000x, which is

the examination under the AFM. This also allowed for easy storage for each of the samples.

Once the samples were collected, it was time for the observation and analysis stages of the experiment. The first few weeks consisted of training to guarantee ample knowledge of the atomic force microscope. Gold tipped probes were selected and purchased due to their better quality and performance. It was unknown at the time that these probes would arrive individually, not mounted to the magnetic strips as was expected. This resulted in the probes then having to be hand glued onto the magnetic strips. This was due to the lack of equipment needed to accurately and precisely mount them. Ultimately, the probes were mounted askew and resulted in faulty scans that could not be used to represent accurate results. Once this issue was addressed, an automatic probe mounter was purchased, but failed to arrive before the deadline of this research. Unfortunately, no useable scans were received over the course of this research, resulting in no beneficial results pertaining to the primary objective of this experiment. However, the foundations of this research have established an advantageous understanding of the mechanics of this microscope.

Figure 1. A scan of the optical reference with the training probes.

Figure 2. A scan of the optical reference with incorrectly mounted probe.

Conclusions

It is important to understand that although the main objective of this lab was never fully explored, valuable experiences have come of it. The steps and methods utilized to acquire the gunshot residue nanoparticles needed for the experiment proved to be problematic in the first few attempts. However, once the problems were assessed, a better method for obtaining the samples was established. Also, spending countless hours working with the atomic force microscope provided a serviceable experience considering knowledge of this instrument can be used in further research. It is well understood now that proper techniques must be applied in order for this microscope to function properly. In the future, probes will be mounted correctly to ensure that the data found is accurate and reliable. Sadly, time was short and the resources were simply not available in time. If they had been, it is very likely that valuable data would have been the outcome of this experiment. As an extension of this experiment, additional barrel lengths would be tested, as well as, various gun powders that burn at different rates.

References:
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