

ACS AMA: Hi, Reddit! I am Dr. Suzanne Bell, Chair of the Department of Forensic and Investigative Science at West Virginia University. Ask me anything about the chemistry of gunshot residue or educational opportunities in forensic chemistry.

AmerChemSocietyAMA¹ and r/Science AMAs¹

¹Affiliation not available

April 17, 2023

Abstract

ACS AMA Hi Reddit! My name is Suzanne Bell, and I am the Chair of the Department of Forensic and Investigative Science at West Virginia University. I teach and conduct research in analytical and forensic chemistry and work with students from undergraduate through PhD. I joined the faculty here in 2003. Prior to then, I worked for the New Mexico State Police Crime Laboratory, Los Alamos National Laboratory, and Eastern Washington University. My PhD is from New Mexico State University. Beyond my faculty work, I served on the National Commission on Forensic Science as Chair of the Research and Scientific Inquiry Subcommittee. I also served as a commissioner on the Forensic Education Programs Accreditation Commission, and am currently an associated editor for chemistry for the Journal of Forensic Sciences. Additionally, I am a member of the ACS Experts program (www.acs.org/experts). This is my second AMA with the ACS – you can see the previous session here <https://redd.it/35pi9d> Continuing on with that discussion, there is a lot of chemical analysis that goes into determining what evidence gunshot residue might provide. Some of the methods we use include scanning electron microscopy (SEM), X-ray spectroscopies including energy-dispersive (EDS), and many types of mass spectrometry (MS). Note that in this discussion I am not an expert on tool markings or ballistics (ie physical marks caused by weapons nor trajectory of bullets). Ask me anything about forensic chemistry and how we apply it in shooting cases, or what educational paths are possible in the forensic sciences. I'll be back at 1 pm EDT (10 am PDT, 5 pm UTC) to answer your questions, ask me anything!

[REDDIT](#)

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Hello and thank you Dr. Bell for taking time out of your day to do this!

When you are checking for GSR on a victim's clothing, what exactly are you looking for?

[asutch12](#)

Happy to take time. When a firearm is discharged, it creates inorganic and organic residues collectively called firearms discharge residue (FDR). The inorganic portion from the primer is officially "GSR" and consists of tiny particulates that contain metals such as barium, antimony, and lead. That is what traditional forensic methods look for. The organic residues (OGSR) come mostly from the propellant and contain stabilizers from the powder such as diphenylamine and other related compounds.

Hello and thank you Dr. Bell for taking time out of your day to do this!

When you are checking for GSR on a victim's clothing, what exactly are you looking for?

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[asutch12](#)

We look for the organic and inorganic residues that are produced when the gun is fired. GSR comes from the primer and it consists of tiny particulates that contain metals such as barium and lead. The organic residues are from the propellant. It is a rich mixture of evidence

Are there other substances that could test positive for GSR? Does GSR not come off with soap and water? If it does, could you test the sink or drain for it? Does gunshot residue degrade? Can it be used to age something? Thanks

[gator_feathers](#)

Hi. The advantage of GSR type evidence is that it has specific physical and chemical characteristics that limit the possibility of false positives. The size and shape of the particles are as important as the elements found in them. Similar findings are possible with deployed airbags (!!). This is because these bags inflate based on rapid gas formation and burning of propellants. Fireworks and brake linings have also been studied as possible sources of false positives.

Is there such a thing as a GSR-free bullet?

[MarineOG](#)

Good question. Actually GSR doesn't come from the bullet but rather the cartridge, powder and primer. Since combustion is never without residues, I see no way to create GSR free ammunition.

What would you say has been the most groundbreaking forensic advancement in the last 10 years?

[robosc_16](#)

Good question. Two things come to mind - laser scanning methods for 3D documentation of crime scenes, and integration of advanced mass spectrometry into forensic toxicology. Unfortunately, both are quite expensive so not all labs have access to them yet.

Hi Doc! Can you determine anything about the cartridge or firearm by gsr?

[ampliora](#)

Rarely. You do see copper in discharge residues, but that can come from the cartridge or the bullet.

Do you think forensic labs would benefit in separating themselves from the law enforcement or district attorneys offices and how would they benefit? By this I mean the lab becoming their own separate department in the counties or cities they are located, instead of being under the direct line of command of a law enforcement agency or district attorney office. Thank you.

[creakinator](#)

Yes. I think that is the best way to insure that the science is independent from any influence, be it the prosecution or defense. I think it will also help insure equal access to forensic services.

Is there a method to easily differentiate the *type* of gun powder?

I have never thought of this specific issue, but I do a bit of spectroscopy and gas chromatography at work. My background is in conservation biology, and I have worked with a lot folks who make and pack their own rounds. I'm wondering if these would be indentifiable and if differences could be measured.

[crowcawer](#)

Different powders (before combustion) are usually pretty easy to tell apart. Once combustion occurs, it becomes very difficult because the process is so variable and the amount of material is so small.

Looking towards the future, what is one thing you hope the field of forensics will be able to do? Like is there something from a sci-fi story that you hope becomes actuality in forensics?

[AlopeLago](#)

I would love to see more AI in the field across the board, from crime scene reconstruction to DNA mixture identification, cases where computing power can integrate all kinds of information.

Hi Dr. Bell: I am curious if there exist job opportunities in forensic science for PhDs trained in cell/molecular biology, or related life-science fields, without formal training in forensics. Or, are there any post-doc and/or certificate-type training programs (that you know of) that current PhDs may pursue in an effort to secure such jobs? Thanks!

[michaelrw10](#)

Hi. Yes, there are. Cell and molecular bio is excellent preparation for DNA related work. For those types of jobs, familiarity with the forensic field is needed, but not necessarily formal coursework. The federal labs (FBI, ATF, DEA, etc.) hire PhDs. There is a new program to create forensic post-docs but those opportunities are harder to find. NIST is also a possibility as there are becoming more active in forensic research. I have place several of my PhD students (chemistry) in labs including with DEA.