

# Deep UV Resonance Raman Spectroscopy (UVRR) for the Detection of GSR

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## **Abstract**

This project aims to address a critical unmet need in forensic science: the development of a validated, efficient, and non-destructive method for the detection of organic gunshot residue (OGSR), especially in cases involving lead-free ammunition, where traditional inorganic GSR (IGSR) analysis is often inconclusive. The major goal is to develop a universal method for the detection of GSR using deep UV resonance Raman (UVRR) spectroscopy. Conventional GSR analysis relies on SEM/EDS which only detects IGSR but is limited by high operational cost and a time-consuming workflow. Its efficacy is compromised by the growing use of lead-free ammunition, which lacks the characteristic IGSR triad (lead, barium, and antimony), leaving many forensic cases involving GSR inconclusive. Raman spectroscopy is the most selective spectroscopic technique, it is inherently non-destructive, requires minimal sample preparation, and is sensitive to the molecular signatures of OGSR components. However, traditional Raman spectroscopy is limited by fluorescence interference. This project proposes the use of UVRR which can be a very valuable tool for collecting spectra of GSR because of the simultaneous coupling of electromagnetic radiation with the electronic charge localized in chromophores, eliminating fluorescence interference and increasing Raman signal intensity. To the best of our knowledge, UVRR has never been applied to GSR analysis, making this a novel and potentially transformative advancement in the field. This project will streamline the entire forensic workflow by developing a universal method for the detection of GSR using UVRR. This project is supported by Award No. 15PNIJ-24-GG-03857-NIJB awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect those of the U.S. Department of Justice.