IDENTIFICATION OF TRACE EXPOSED RESIDUE ON COMPOSITE MATERIALS FOR FORENSIC APPLICATIONS VIA RAMAN SPECTROSCOPY

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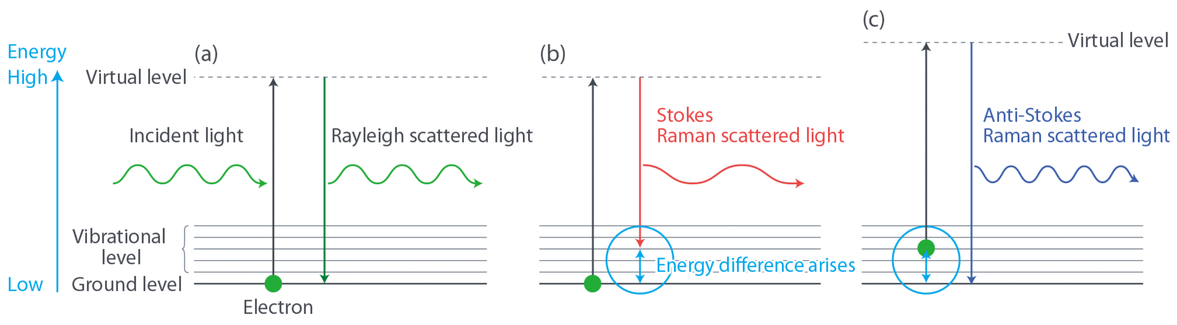
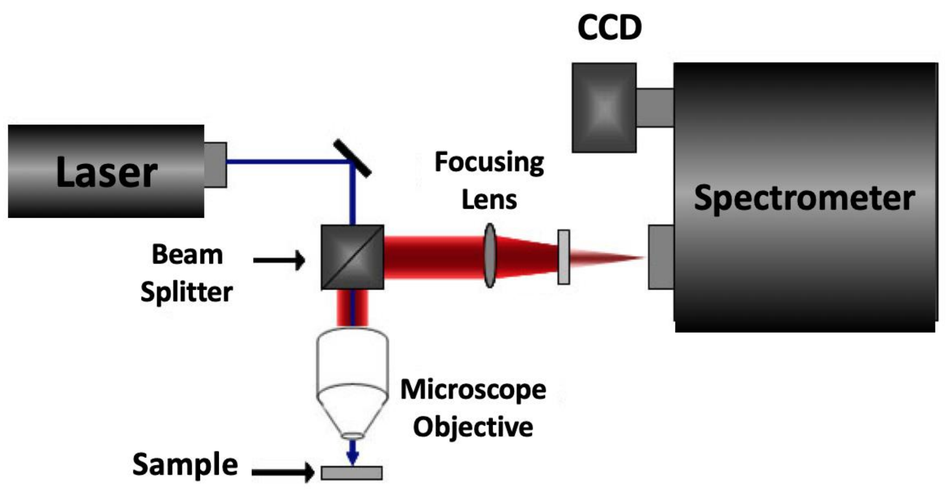
Abstract

Raman spectroscopy has been started to use in forensic applications for last twenty years for determination of incident time or detection of microtraces from the environment. It is non-destructive, non-contact method while providing rapid examination without the necessity of complex sample preparation steps and has possibility of application on a wide range material. Although the fundamental principle of this method is known almost one hundred years, extensive potentialities which Raman spectroscopy offers are finally being able to utilized with technical advancements and novel engineering solutions of the recent years. In this study, long-ranged shots were investigated to obtain some possible material transfer between the bullet and the target by using Raman spectroscopy and Surface Enhanced Raman spectroscopy (SERS). Different sample preparation methods, surface enhancement methods and effect of different sources on the collected data also discussed. There is a non-ignorable difference in between Raman signals of non-interacted surface of the targets and its bullet holeimpacted areas. The result is promising in terms of forensic applications of Raman Spectroscopy due to possible matter transfer from bullet to target. By using characterization of transferred material, some information about bullet and gun in long- ranged shots may be obtained in the future once a successful database is obtained.

Introduction

- By detecting Raman signals, characteristic energy differences between vibrational levels of Raman active molecules is used for characterization.



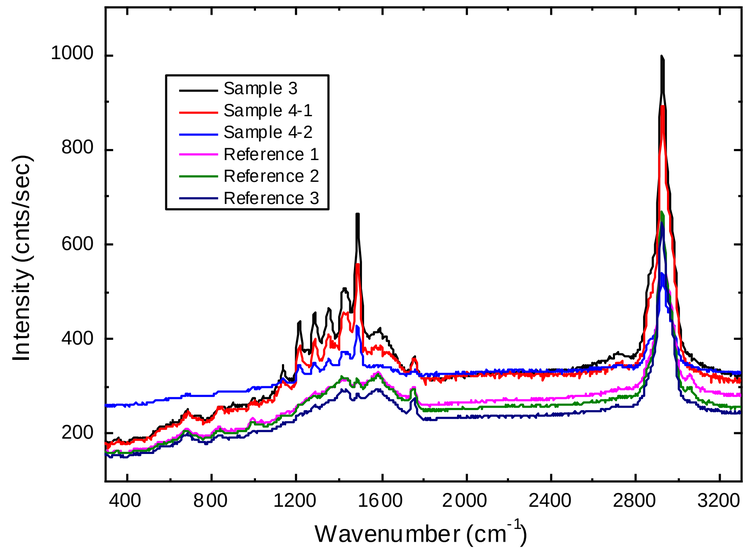


- Possible to measure samples in different forms such as powder, crystal, fiber, thin layer, gel, solution with no concern with sample size, shape or thickness.
- Its usage in forensic sciences has increased in last two decades
- Organic compounds are mainly found in propellant powder and the primer mixture but they can also arise from every part of the ammunition used.
- Propellant of the bullet and its products of burning and half burning reactions are possible sources of investigated transferred material
- In this study, only long-ranged shots are investigated to obtain any detectable material transfer from the bullet to the target as a result of the impact

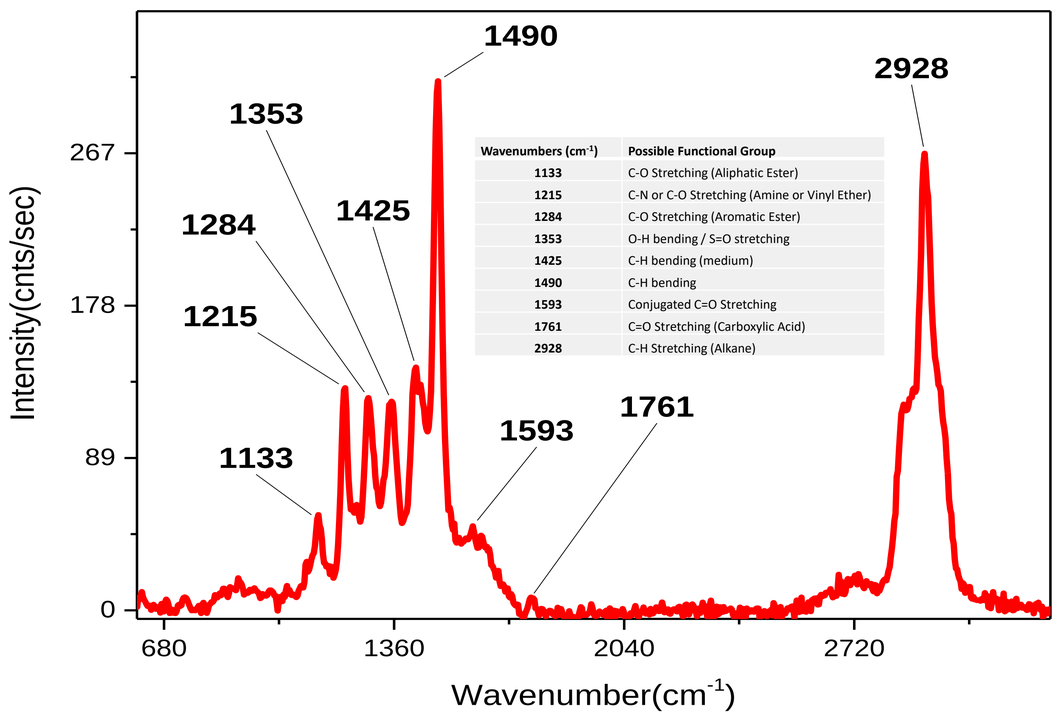
Experimental

- Direct determination of possible material transfer from targets by using 532 and 632.8 nm laser without any sample preparation and signal enhancer method was not successful
- Sample collected from bullet hole region of targets by using sterile cotton buds and ethanol. Sample solutions were introduced on silicon wafers and ethanol was evaporated on hot plates at 79°C for the measurements
- To enhance Raman signals, Colloidal AgNW solution and analyte solution were mixed and introduced onto silicon wafers
- A set of sample which was directly introduced on AgNW foil also was prepared

Results



- There is a non-ignorable difference in between Raman signals of non-interacted surface of the targets and its bullet hole regions. This result is promising in terms of forensic applications of Raman Spectroscopy due to possible matter transfer from bullet to target.



Conclusion

- Result of the study is promising in terms of forensic applications of Raman spectroscopy due to possible matter transfer from bullet to target.
- A further study with more number/type of targets is needed to justify this possible material transfer
- Reference correction was applied but revealed material from lower layers of targets during impact may cause false positive signals
- Obviously, further studies for building a reference database is needed for characterization of transferred material and consistent interpretation for forensic purposes

Acknowledgement

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References

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