

**Séance 3: Matière rédaction de  
mémoire et recherche documentaire**



**Pr Mohamed HEMIS**

# RÉFÉRENCES BIBLIOGRAPHIQUES

- Actuellement deux systèmes de présentation des références sont utilisés:
  - Système Harvard ou système (name, date); dans un texte on écrit par exemple: Hemis et al (2018) studied the heat and mass transfer in porous medium and new model was developed to model drying process.
  - Système Vancouver (système numérique [1]; par exemple: Heat and mass transfer in porous medium was studied in which new model was developed to model drying process [34])
  - **Références:**
- Hemis, M., Gariépy, Y., Choudhary, R., & Raghavan, V. (2017). New coupling model of microwave assisted hot-air drying of a capillary porous agricultural product: Application on soybeans and canola seeds. *Applied Thermal Engineering*, 114, 931-937.

[34] Hemis, Mohamed, et al. "New coupling model of microwave assisted hot-air drying of a capillary porous agricultural product: Application on soybeans and canola seeds." *Applied Thermal Engineering* 114 (2017): 931-937.

# TECHNIQUES ET NORMES DE RÉDACTION

## Rôle des ateliers

Cours, lire des livres,  
..ect

Mise en forme; la numérotation des chapitres (I ou 1), des figures (I.1 ou 1.1) et des tableaux, figures et équations est similaire.

La page de garde (respecter celle trouvée dans le guide du département, faculté ou l'université).

**La rédaction, la langue scientifique (l'étudiant doit apprendre à utiliser l'internet pour rédiger ces propres phrases courtes et simples et ne pas copié ceux d'autres personnes.**

Amélioration des compétences linguistiques générales

Sauvegarder, sécuriser, archiver les données sur au moins deux support (USB et Un PC)

# EXPOSÉS ORAUX ET SOUTENANCES

1

**Comment présenter un poster**  
**Un seule format A2 OU plus;**  
**Qui contient: Titre, auteurs + affiliation**  
**Introduction; Matériels et méthodes; résultats et discussion; conclusions + références**

2

**Comment présenter une communication orale; en 10 à 20 minutes parler sur l'essentiel de votre travail**

3

**Soutenance de mémoire**  
**20 à 25 minutes; utiliser entre : 15 à 25 diapos**  
**L'étudiant doit résumer son travail en se basant beaucoup plus sur les schémas, figures et tableaux;**



# EPR Spectroscopy for the Forensic Analysis of Glass

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## ABSTRACT

Increasingly sensitive instrumentation and new, creative, flexible analytical methods are helping forensic scientists utilize trace evidence more efficiently and effectively than ever before. Processes that allow investigators to quickly identify and/or compare samples are becoming more and more valuable, especially if the cost of the analysis can be kept to a minimum.

It is not unusual to find broken glass at the scene of a crime and this trace evidence can be very useful for connecting an individual to the offense. Currently, the most successful means of analyzing glass fragments involves evaluating the chemical composition of the sample. This requires large, expensive instruments, like an inductively couple plasma mass spectrometer (ICP-MS), as well as intensive and destructive sample preparation unless laser ablation is applied.

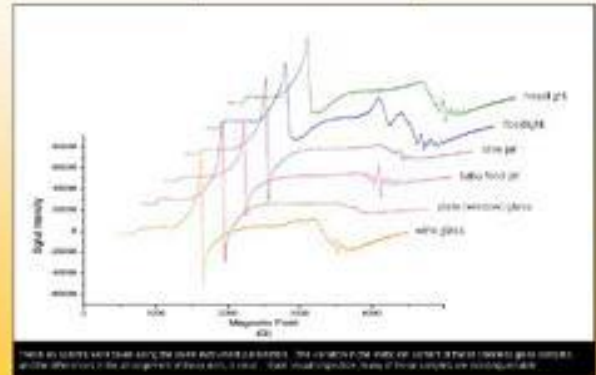
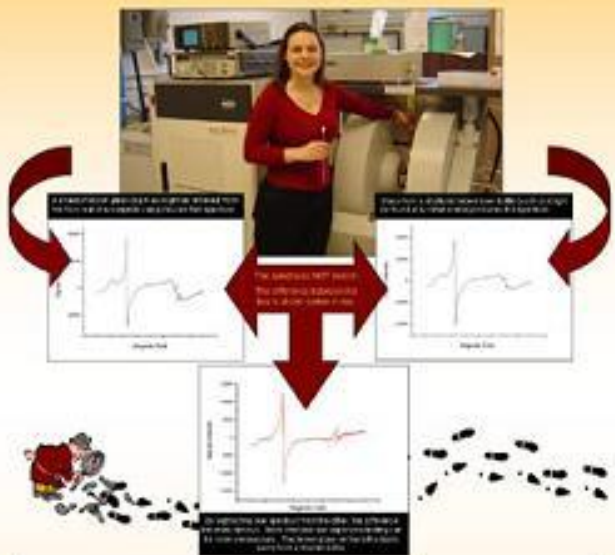
The research completed here has shown that electron paramagnetic resonance (EPR) spectroscopy can be used to compare glass shards to determine whether or not they came from the same source. By reducing the range of the required magnetic field, a smaller, more cost-effective instrument can be developed. This means of analysis is fast, requires little to no sample preparation, and is non-destructive.

## GLASS AS FORENSIC EVIDENCE

- Glass can be used as valuable associative evidence by linking an object or person to a crime. Because of its non-toxic and transparent nature, glass fragments often leave the crime scene on the clothes, skin and hair of even the most careful criminal.
- In the past, glass was analyzed using primarily physical characteristics, including color, density and refractive index. A decrease in the number of glass producers, combined with an increase in quality control standards, has led to a drastic reduction in refractive index variability.
- Analysis are now being forced to discriminate between glass samples using their chemical composition. Many of the molecular level methods take advantage of trace metals that are found within the matrix of glass. These can be introduced intentionally as modifiers or to add color to the glass. In addition, a number of metal ions are often present as impurities in the supplies (e.g. sand) used to produce the glass. The trace metal compositions of such starting materials are unique to their source.
- The FBI has had success using inductively-couple plasma analysis to compare the trace metal composition of automobile side windows<sup>1</sup>, but such instruments are very expensive and require specialized training of the operator.

## ELECTRON PARAMAGNETIC RESONANCE SPECTROSCOPY

- Electron paramagnetic resonance (EPR) spectroscopy detects the presence and arrangement of unpaired electrons, like those carried by many of the metal ions found in glass. By submitting a sample to microwave frequency radiation and a variable magnetic field, it is possible to determine the particular field strength at which resonance occurs for each kind of unpaired electron present.
- The spectrum produced during the EPR analysis of a glass sample is affected by the kinds of metal ions present, their environment and symmetrical orientation, and their concentration. Because of the number of factors affecting the spectrum for each sample of glass and the enormous variation, on the chemical level, between samples, an EPR spectrum has the potential to act like a "fingerprint" for a single glass source.
- EPR is capable of analyzing solid samples with very little preparation time and it does not destroy the fragment, so that the evidence has not been lost and further testing is possible if necessary or desired.
- Affordable, tabletop EPR spectrometers can be designed for a specific purpose and are already in use in a number of industries.



Note: All spectra were taken using the same microwave parameters. The variation in the shape and position of these stacked glass spectra is due to differences in the alignment of these ions, a result of their multidirectional nature of these samples on microscale level.

## METHODS

- Glass samples from over two dozen sources were collected, documented, washed with soap & water and air dried. The samples were placed in plastic bags and shattered with a hammer.
- The analyses were performed using the new Bruker EPR spectrometer pictured here.

## RESULTS

- A wide variety of glass samples were tested at different instrument settings. It was found that EPR spectra can be obtained at maximum power and modulation amplitude without spectral distortion. However, a lower power of 13.55 mW is the best compromise between sensitivity and instrument stability.
- Although EPR analyses often benefit from measurement at liquid nitrogen temperature (77 K), it has been found that the signals in glass samples are sufficiently strong at room temperature.
- EPR spectra measured between 500 G and 4500 G have been proven sufficient for discriminating between glass samples. Literature and research reported here have identified characteristic resonances for iron(II), manganese(II), vanadium(V) and copper(II), four of the metals prevalent in glass samples.

## CONCLUSIONS

- Research published in the 70's suggested that with increased sensitivity EPR could be used to discriminate between glass samples<sup>2</sup>. The research here has proven that current instrumentation provides the necessary sensitivity to apply this method for forensic purposes and that visually identical glass samples can be readily distinguished by EPR.
- In addition, the magnetic field requirements and instrument parameters have been established that would allow for the development of a dedicated tabletop instrument.
- Continuing research is being done on additional glass samples to further establish the general applicability of EPR to forensics.



<sup>1</sup>W. A. Pryor, J. R. H. Hunt, and J. R. H. Hunt, "Forensic Analysis of Automobile Side Windows by Inductively Coupled Plasma Atomic Emission Spectrometry," *Journal of Forensic Sciences*, vol. 30, no. 1, pp. 1-10, 1985.  
<sup>2</sup>W. A. Pryor, J. R. H. Hunt, and J. R. H. Hunt, "Forensic Analysis of Automobile Side Windows by Inductively Coupled Plasma Atomic Emission Spectrometry," *Journal of Forensic Sciences*, vol. 30, no. 1, pp. 1-10, 1985.

# COMMENT ÉVITER LE PLAGIAT

1. Formules, paragraphes, graphes, données ou statistiques doivent avoir une citation c'est-à-dire une références bibliographique [REF].
2. La paraphrase (**Reprise d'un texte sous une autre forme (en général plus développée et plus explicative)**).
3. Indication complète de la référence bibliographique



# LE PLAGIAT

- Il est assimilé à un vol; il s'agit de copier un auteur en copiant des passages de son travail.

## LES DIFFÉRENTES FORMES DE PLAGIAT

1. Reproduire intégralement un contenu disponible sur internet, sur des livres ou sur autres catégories de documents,
2. Prendre des extraits en ignorant les guillemets et les citations,
3. Reformuler le document original et ne pas citer la référence (**plagiat déguisé**),
4. Charger une autre personne de l'élaboration du travail de recherche (**Ghost writing**)
5. La traduction d'un texte sans mentionner la référence de son origine

## QUELQUES TECHNIQUES POUR ÉVITER LE PLAGIAT

- L'étudiant doit y avoir le réflexe de mettre entre guillemets «un texte qui **ne doit pas dépasser les 40 mots** » tout extrait d'un document d'autrui inséré littéralement dans son travail, suivi par la référence du texte copié.
- Il doit inscrire les références des documents utilisés au fur et à mesure qu'il avance dans son travail,
- Évitez le travail de la dernière minute;
- Si vous travaillez en binôme, choisissez votre collègue de PFE de même niveau que vous;



Merci de votre attention