A142 Revisiting Glass Fracture Examination and Interpretation in Forensic Casework

Craig L. Heummer, MS, New York City Police Lab, 150-14 Jamaica Ave, Jamaica, NY 11432; Nicholas Petraco, MS, 73 Ireland Pl, Amityville, NY 11701; Mary Eng, BS, New York City Police Lab, 150-14 Jamaica Ave, Jamaica, NY 11432; and Nicholas D. Petraco, PhD, John Jay College, 454 W 59th St, New York, NY 10019*

After attending this presentation, attendees will know about the scientific terminology used in glass fracture analysis, how to avoid common pitfalls when determining the direction of force, and how to distinguish between various types of glass fractures.

This presentation will impact the forensic science community by introducing the proper scientific terminology for describer fractures in glass.

During crime scene investigations and reconstructions involving broken or fractured panes of glass, it is often of vital importance whether or not a location or vehicle was entered from the inside or outside. In burglary investigation, whether a pane of glass was shattered with a tool, struck with a baseball bat, or cut with a glass cutter is crucial information for the investigating detective to know. Whether the glass window was broken or cut from inside the premises or outside the premises is crucial to the burglary investigation. Investigations involving arson can often be advanced by knowing if the glass windows were broken by thermal radiation, a projectile, or some other type of physical force. Events involving firearms, bullet holes, and bullet trajectory can often benefit greatly from a thorough and complete scientific evaluation of the glass fractures. The sequencing of bullet holes is often very important to reconstructing a crime scene or event. Determining which bullet hole was made first, or whether a bullet hole was made from outside-in or inside-out of the premises is often crucial to an investigation. In leaving the scene of accident investigations involving fractured windshields, studying the scattered windshield can often help determine who was driving the vehicle and who was a passenger, where the occupants were siting, how fast the vehicle was going, and much more. Such issues have been studied and discussed by forensic scientists for nearly a century, and many have published their work in the forensic literature.[1-12] Unfortunately, although much of the published information is useful and scientifically accurate, the nomenclature used for fracture marks is often confusing, and has been frequently misused in the scientific literature.[13] In the mid 1980s, two forensic scientists addressed some of these issues; however, more work stills needs to be carried out.[14]

This study delves into the scientific methods and terminology used by those material scientists that study the fractography of brittle materials such as glasses and ceramics. The basic definitions of natural and synthetic glasses, as well as the various types of commercial glass, are presented and discussed. Next, their physical, optical, and chemical properties are reviewed in relationship to how and why these brittle materials fracture. The brittle nature of glass, its elasticity, tensile strength, and the scientific laws and phenomena explaining its behavior are examined and discussed in detail.[15-20]

The proper scientific terminology for commonly used terms such as craters, splintering, rib marks, hackle marks, radial lines, and concentric lines are offered, depicted, and covered in detail. Some common pitfalls in applying the right, rear, radial rule for determining the direction of forces are also advanced. Several case studies are given which illustrate and discuss the scientific laws, and terminology used by the fractography community for describing glass fracture phenomenon and showing how these laws and terms can be applied in forensic casework.

Finally, the goals of this research are to help right these issues in at least the forensic community and to further the use of glass fracture analysis in forensic casework meeting the challenges of the NAS Report on Forensic Sciences.

References:

1. Tryhorn FG. The examination of glass. Journal of Criminal Law and Criminology 1939;30:404-19.
2. Söderman H,. O'Connell JJ. Modern Criminal Investigation, Funk and Wagnalls:New York, 1945.
3. O'Hara CE, Osterburg JW. An Introduction to Criminalistics, Chapter 19, MacMillian and Co:NY, 1952, 239-46.
4. Kirk PL. Crime Investigation, Interscience:New York, 1953, 232-48.
5. McJunkins SP, and Thornton JL. Glass fracture analysis: A review. Forensic Science 1973;2(1):1-27.
6. Rhodes EF, Thornton JL. The interpretation of impact fractures in glassy polymers. J Forensic Sci 1975; 20:274-282.
7. Thornton JL, Cashman PJ. Reconstruction of fractured glass by laser beam interferometry. J Forensic Sci 1979;24:101-108.
8. Locke J, Unikowski, JA. Breaking of flat glass. Part 1: Size and distribution of particles from plain glass windows. Forensic Sci Int 1991;51:251-262.
9. Locke J, Unikowski JA. Breaking of flat glass. Part 2: Effect of pane parameters on particle distribution. Forensic Sci Int 1992;56:95-106.
10. Locke J, Scranage JK. Breaking of flat glass. Part 3: Surface particles from windows. Forensic Sci Int 1992; 57:73-80.
11. Curran JM, Hicks TN, Buckleton JS. Forensic Interpretation of Glass Evidence, CRC Press, 2000.
12. Gardner RM. Practical Crime Scene Processing and Investigation, CRC press, 2005, 35-39, 298-300.
13. Frechette VD. Failure Analysis of Brittle Materials, Advances in Ceramics, Vol. 28, The American Ceramic Society, Westerville, Ohio, 1990, 9.

 ** Presenting Author*

14. Thornton JL, Cashman PJ. Glass fracture mechanism: A rethinking, J Forensic Sci 1986;31:818-824.
15. Chaudhri MM. Kurkjian CR. Impact of small steel spheres on the surface of 'normal' and Thornton, JL, Anomalous glasses, Journal of the American Ceramic Society 1986;69:404.
16. Frechette VD. Failure Analysis of Brittle Materials, Advances in Ceramics, Vol. 28, The American Ceramic Society, Westerville, Ohio, 1990.
17. Bradt RC, Tressler RE, editors. Fractography of Glass, Plenum Press, 1994.
18. Varner JR, Frechette VD, Quinn GD, editors. Fractography of Glasses and Ceramics III, Ceramic Transactions, Volume 64, The American Ceramic Society, Westerville, Ohio, 1996.
19. Kurkjian CR, Gupta PK, Brow RK, Lower N. The Intrinsic strength and fatigue of oxide glasses 2003 Journal of Non-Crystalline Solids 2003;316:114 -124.
20. Bach H, Krause D, editors. Analysis of the Composition and Structure of Glass and Glass Ceramics, Springer, Germany, 1999.

Fractography, Hertzian Conoid, Wallner Lines

 ** Presenting Author*