VOLUME 1 SUMMER 1993

THE *SEM* INAR

The newsletter that addresses the *probing* concerns of Forensic Science

Beginnings . . .

This is the first issue of what, we hope, will be many newsletters directed to the community of people interested in SEM in Forensic Science.

Particularly now, with the economy wreaking havoc on our travel budgets, we are denied the opportunity for frequent, meaningful discussions and get-togethers with other people in the field of SEM who could help us perform our jobs better. We do have access to the journals, but they are a poor substitute for peer communication. This effort to assemble a newsletter, then, is intended to produce a forum for communication among people using SEM (and perhaps XRF) in Forensic Science - consisting of articles, information, methods, research - anything that would be of interest to others in the field.

Traditional newsletters arise from well-intentioned efforts, but die an early death when a lone author cannot maintain the incredible workload required to perpetuate it. Given that foresight, we perhaps can be more successful by using a previously demonstrated sure-fire winner: the electronic bulletin board concept. This format ensures informal, frequent, and spontaneous contributions from subscribers. In the interest of accessibility and economics, however, our transmission medium will be paper.

This is definitely not going to be a newsletter written entirely by the editor alone. He will perform publishing functions, letter construction, mailing list maintenance, and encourage contributions. After the layout is complete, the editor will submit the final draft to 2 subscribers (selected almost randomly) for review, comments, and acceptance. We intend to publish roughly quarterly.

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USE OF THE SCANNING ELECTRON MICROSCOPE TO EXAMINE FIBER IMPRESSIONS ON TYPEWRITER CORRECTION RIBBON

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When a correction ribbon is used to correct a typewritten document, fiber impressions from the paper are impressed upon the ribbon. Previous research utilized a comparison microscope to match fibers and fiber impressions between a correction ribbon and

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Filament life . . .

Generally, tungsten filaments will last about 40 to 80 hours, or to the middle of a critical analysis or demonstration, whichever comes first. Why do they burn out prematurely? It could be for two reasons - poor vacuum, or over saturation. Poor vacuum can be from a

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a document. However, due to inherent features of the correction ribbon system, several difficulties were encountered. Consequently, a scanning electron microscope (SEM) was used to alleviate some of the problems discovered by past research. The SEM, with its greater magnification power, detected both fibers and fiber impressions, creating a basis for association between a questioned document and a correction ribbon. Use of SEM also ameliorated the problems of past research and greatly enhanced points of comparison.

Because the SEM has greater magnification and clarity than a comparison microscope, we expected it to increase depth of field, enhance contrast, and show numerous, highly detailed points of comparison. To our knowledge, this method of analysis has never been tested.

Our approach to this research attempted to recreate the office conditions in a typical military working environment. Two typewriters, common in the Air Force, were selected:

- a Panasonic typewriter, Model RX-E3000, in use since 1990, equipped with a Panasonic Electric Typewriter Ribbon, Correctable Ribbon Model SKX-E20.
- an IBM Wheel writer 10, Series III, in use since 1982, equipped with an IBM Selectric System/2000 "Wheel writer" 3 & 5 Lift-off tape.

We created our own questioned documents on government letterhead and bond paper. Two corrections for examination were made on each type of paper. Specific areas to be examined were cut out from the test paper and ribbon. These portions of paper and segments of ribbon were then mounted on a glass slide with metal conductive tape. Each sample was lightly sputter coated with gold using the EmScope SC500 Sputter Coater. Samples were examined with the Hitachi S-570 Scanning Electron Microscope, using 12 kilovolts accelerating potential at a magnification of 170 X.

Each of our four samples was examined in the following manner: using the SEM, fiber impressions were located on the portion of the ribbon that corresponded to the questioned area of correction on the document. These impressions were then photographed using the Polaroid camera affixed to the SEM. Next, the questioned area of correction on the document was located and photographed. These photographs were then used for comparison.

- The samples were then examined using the American Optical Corporation UFM-2 forensic Comparison Microscope (Model K2031A) equipped with 1.22, 2X and 4X objectives and a fiber optic illuminator. Using the 4X objective, the samples were examined for the same points of comparison found under the SEM. The resulting examination yielded questionable results. Only a few fiber impressions could be located but we could not state, with any degree of certainty, that the comparison was a match. These impressions were then photographed.

While the use of a SEM may seem costly, we found that the cost per sample was approximately $100.00. It took approximately three hours to prepare, locate, and photograph each set of fibers and fiber impressions. The skills of a competent SEM technician were essential to our quick and successful results.

This method may best be used in situations where fiber impressions are not easily identifiable with the comparison microscope. We noted few problems with this form of analysis. While this method is somewhat destructive in that the ribbon and paper will never be able to be restored to their original condition, the sputter coated ribbon and paper stay intact for repeated examination, if necessary.

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At first we feared that the ribbon may be susceptible to destruction due to conditions encountered within the SEM. however, no such problem occurred. Additionally, the adhesive on the correction ribbon did not melt or stick to the equipment.

All total, the use of a SEM to detect fibers on documents and fiber impressions on correction ribbons provides a basis for a positive identification, with less difficulty and greatly enhanced of comparison. Future applications for the SEM should be considered and researched in the forensic sciences.

note: The SEM for this research was provided by Nick Madary at the Armed Forces Institute of Pathology, Washington, DC. This paper was presented at the 1993 MAAFS meeting, Baltimore MD, on May 20.

"The Application of Energy-dispersive X-ray Fluorescence Spectrometry (EDXRF) to the Analysis of Cosmetic Evidence in Indian Nail Polishes", Appl. Radiat. Isot. Vol. 43, No. 5, pp. 609-614, 1992.

G. Misra, et al, compared smears of nail polishes on filter paper by Energy Dispersive X-ray Fluorescence Spectrometry. Limited numbers of similar colors were found to have significant inorganic differences. A radioisotope source (30 mCi 238Pu) was used for irradiation. Comparisons were quantitative for 11 elements. Sample size is not indicated.

G. Misra, Forensic Science Laboratory, Punjab, Plot No. 2, Sector 9-A, Chandigarh 160009, India.

Dennis Ward, FBI

MEETINGS . . .

Southern Association of Forensic Scientists (SAFS), Sept 6-9, Charleston, SC

Midwestern Association of Forensic Scientists (MAFS), Oct 9-14, Madison, WI

Northeastern Association of Forensic Scientists (NEAFS), Oct 14-16, Springfield, MA

Northwest Association of Forensic Scientists (NWAFS), Oct 19-22, Boise, ID

Midwestern Association of Forensic Scientists (MAFS), Oct 11-16, Cleveland, OH

Canadian Society of Forensic Science (CSFS), Sept 8-12, Winnipeg, Manitoba, Canada

SCHOOLS . . .

SEM and X-ray Microanalysis, Oct 25-29, State Univ of NY, New Paltz, NY

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number of reasons, from a hair bridging a gasket seal to low oil level in the backing pump. Vacuum concerns will be addressed in a future TOOLBOX column.

Selection of a saturation setting can result in a filament life from only several hours to many hundreds. When saturating, image the filament by observing the emission as a waveform, or an actual image. As the filament current is increased, filament emission increases proportionately, until the point of saturation. This is the point that is usually recommended for general analysis. Unfortunately, however, this is not a specific "point" but a "range". The question then becomes one of proper selection of the portion of the range for optimal saturation.

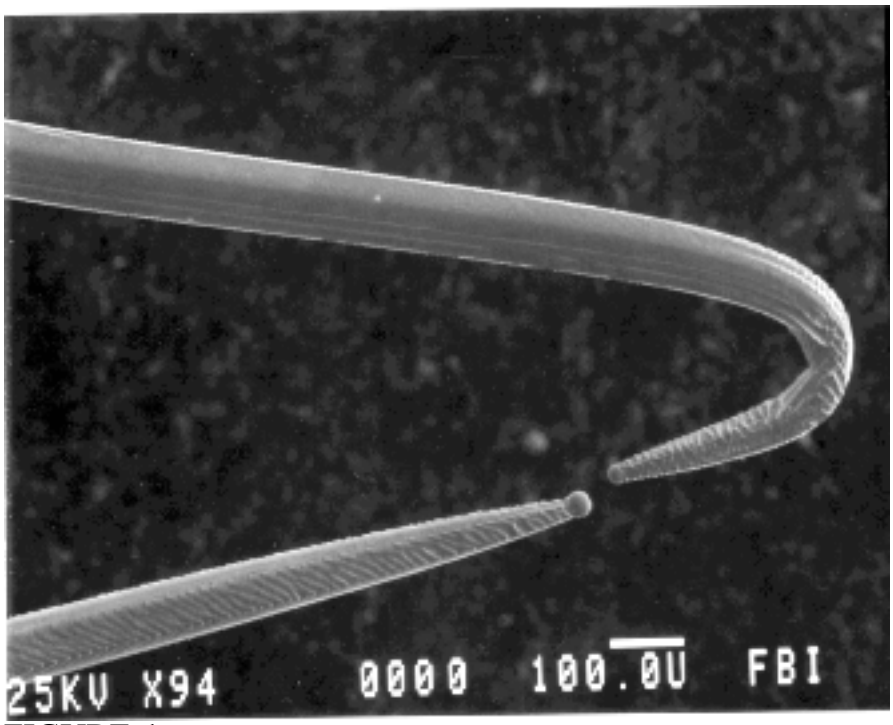

FIGURE 1

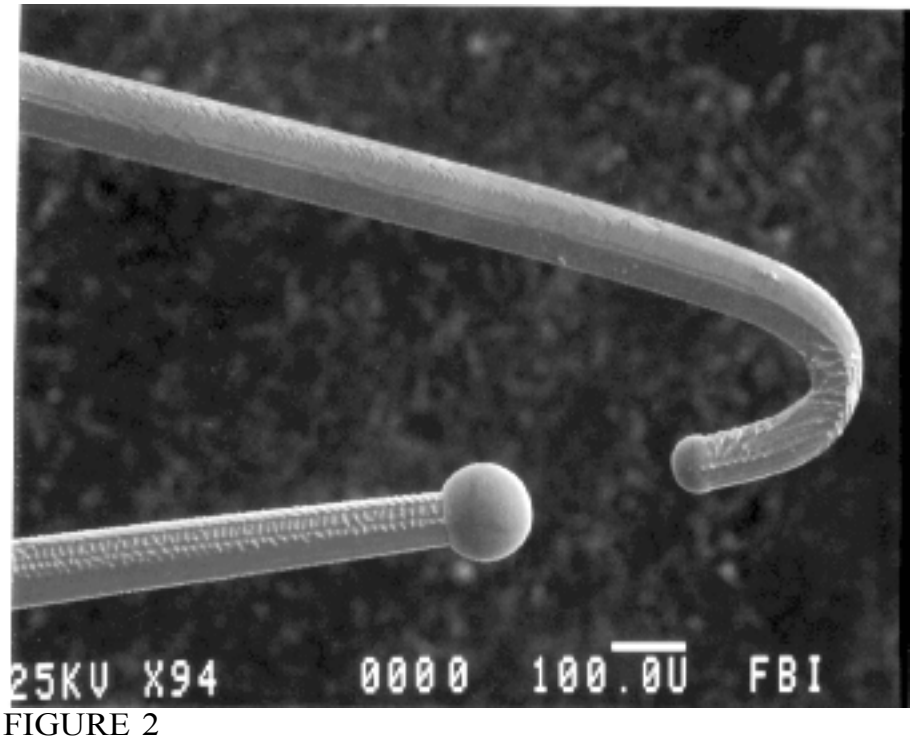

FIGURE 2

If greater than usual emission current stability is required, (as required for certain quantitative X-ray analysis, and automated GSR searches) the filament current should be increased to the "over-saturated" end of the range. Greater stability is guaranteed, but filament life is less because the filament runs hotter. When saturated at this end of the range, an increase in filament current will result in only a very slight increase in emission current (when observed in waveform), and the center of the emission image will appear as bright as the ring (at conditions of high contrast and low brightness!)

If greater stability is not needed, (for qualitative X-ray analysis, low magnification micrographs) the filament can be slightly under saturated,

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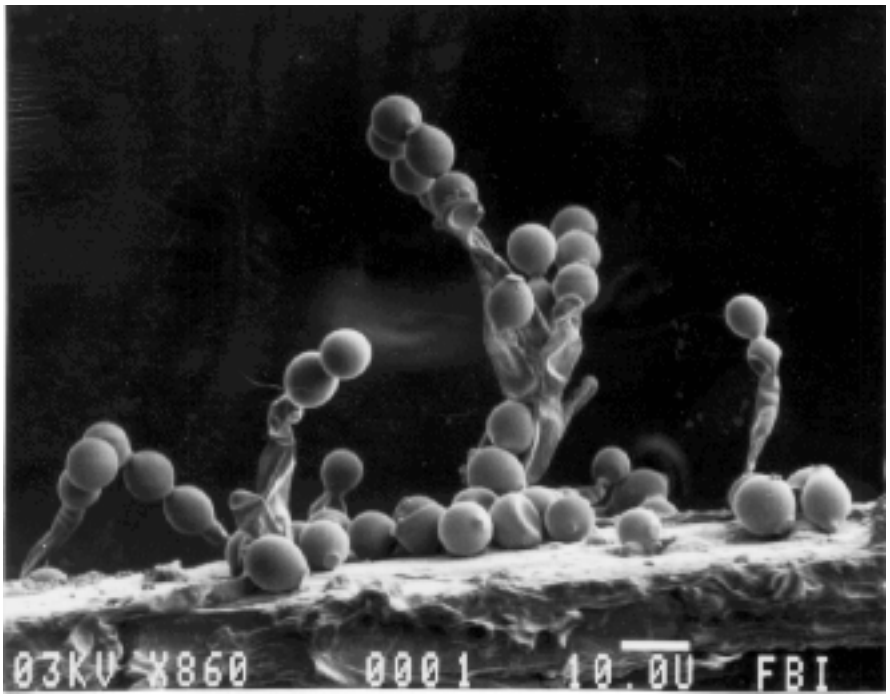
Submissions, including text and drawings, will be scanned "as is" into the final draft. Limited language translation will be available if required.

To be successful, it will be necessary for everyone on the mailing list to contribute something occasionally. Consider submitting any items that you feel might be useful to others in this business. When you attend a local meeting, be a reporter for THE *SEM*INAR. Review a paper. Send an abstract. Remember that most of us will never hear of that talk unless you tell us about it! Tell us about a method you've developed, a study you've undertaken, a war story. . . What about an unusual micrograph? Although the primary intent of this endeavor is the exchange of "important" technical information, relevant topics of human interest are also encouraged, such as your SEM going up in smoke, or your recent promotion to director.

When inspired to write for THE *SEM*INAR, do not agonize over every word and phrase as you would for a journal. Just write as you would in a conversation. If we get a good response the newsletter will continue indefinitely. However, if the contributions diminish, the effort will be abandoned. It is up to each one of us to make THE *SEM*INAR a success!!



The Name Game. . .

No Newsletter is legitimate without a catchy name. A first (but not necessarily best) suggestion is THE *SEM*INAR. Others include; FORSEM, THE *SEM*TINEL, THE *SEM*TINEL QUARTERLY, SEM FORUM, SEM TALK, SEM SPEAK, NEWSSEM, NEWSEM, SEMNEWS. Add your creation to the list, or "vote" for any of the above the next time you communicate with the newsletter. Until we reach a consensus, this newsletter is "THE *SEM*INAR".

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resulting in significantly longer filament life. At this end of the saturation range, an increase in filament current will produce a noticeable increase in filament emission (when observed by waveform), and the center of the emission image will appear darker than the ring.

When a filament finally expires, carefully remove the filament and observe the break area with a light microscope. The filament broke in this area because it was thinnest, resulting in greatest resistance, and therefore greatest heating. The filament in figure 1 had burned several hundred hours. Notice the significant narrowing of diameter of the wire at the point of break, and the small bead formed when the filament did burn through. This is OK (although the filament was over-saturated when it broke!). The filament in figure 2 was over saturated after only several dozen hours, resulting in a large filament current melting a large diameter wire, and a large bead. This is not OK.

The FBI Laboratory has recently ordered an "Omicron" micro-fluorescence EDXRF analyzer from Fisons Instruments. Having the capability of 50 to 100 micron resolution, it should provide the advantages of bulk XRF with the spatial resolution of SEM.

THE MAILING LIST. . .

If you received this newsletter, you are on the mailing list. If this address is incomplete or inaccurate, or the newsletter should be sent to a different or additional individual at the same address, please indicate by returning the address label with appropriate changes. Also include phone number. In the next issue, the entire mailing list will be published, and you will be asked to submit the names/addresses of any additional individuals who should be on the list.

PUBLICATION POLICY

The purpose of THE *SEM*INAR is to promote and foster the timely exchange of ideas, information, and developments within the community of Electron Microscopists in Forensic Science. Articles and submissions from contributors appearing in this publication are not to be considered the opinions or statements of the FBI or as an endorsement for any policy, program, or service by the FBI. Nor are the techniques or methods described in various articles and submissions necessarily considered to have a consensus of support within the scientific community. Contributing authors assume total responsibility for the contents and accuracy of their submissions.

Send submissions and address changes, (including phone number), to:

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