CASE REPORT

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An Unusual Oxidation Type on Bulb Filament After a Car Crash Dive

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ABSTRACT: A car with two dead bodies trapped inside was discovered in a gravel pit. The main hypothesis of investigators was a traffic accident simulation by night. Examination of a broken lightbulb revealed both a rather unusual oxidation type and small rounded cavities never reported before. Tests were performed and allowed forensic scientists to establish that the lightbulbs were switched on during the crash dive, in contrast with the investigators idea.

KEYWORDS: forensic science, criminalistics, bulb filaments, scanning electron microscopy, oxidation type

On a sunny day in June, in the area of Bourg-en-Bresse, France, a Renault model R9 was discovered in a gravel pit after a water level decrease. Two dead bodies were found in the crashed car.

First findings of the inquiry suggested a night traffic accident simulation. Technical police investigations were executed on the car. Two H4 type light bulbs (high beams and low beams) were removed from the front optical sets. The bulbs were covered with a thick layer of mud. One bulb had its protective glass intact, reinforcing the investigators who believed that the lights were not on when water came into contact with the glass bulbs, because such a thermal shock would have destroyed the glass bulb. The second protecting glass bulb was broken, as well as the optical set.

Therefore, the investigators wanted to determine whether this destruction was anterior or consecutive to the vehicle's fall in the gravel pit. These two light bulbs were submitted to our forensic laboratory for analysis.

Examinations

The two light bulbs were covered with a mud layer, which indicated that both bulbs had been in direct contact with water.

The intact light bulb was easily cleaned. Neither ductile type fracture nor deformation were noticed on either filament's coils. The low beam filament's high degree of crystallization demonstrated an important duration of functioning (1): because the car had not been in a violent crash (not a deep fall and relatively weak damages—see Fig. 1), it was not possible to conclude whether or not the lights were on when the car hit the water (2,3).

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The second light bulb was broken and covered with a thicker layer of mud than the first one. Filament coils were practically invisible. Only a cleaning of the light bulb with ultrasounds in solvent (acetone) succeeded in removing this deposit (Fig. 2).

Optical microscopic observations of the high beam filament coil did not show any fracture, oxidation, or significant deformation. Fortunately, the examination of the low beam filament was more instructive. This filament was broken and had a relatively weak deformation of its coil structure (Fig. 3). Moreover, a very deep blue color oxidation was sharply visible on several coil spirals (Fig. 4), which was rather unusual (2–4). The examination also revealed ductile type fractures (hot filament coil) (5,6). Finally, small rounded cavities (40 (m diameter) were observed on the surface of the low beam filament, mainly localized near the fractures (Fig. 5). This was totally unexpected.

Testing

To better understand these phenomena, several tests were performed on about 15 different well-known brands of lights (Norma, Osram, Jahn, and Motorcraft). These light bulbs were collected on old, non-damaged, junkyard cars.

The light bulbs were supplied with a 12V voltage. The first series of tests was performed in an optical set to obtain the standard working temperature of the protecting glass bulb [first, with low beam filament (55 Watts) and second, with high beam filament (60 Watts)]. After 15 min., the light was pulled out from its optical set and directly immersed in a 5-L bucket of water (20°C). During these tests, the lights were not turned off. In a second series of tests, a trickle of water on the glass bulbs (supplied with a 12V voltage) replaced a quick immerse. This test was performed because the way the water came into contact with the light bulbs was unknown.

The results of these tests were surprising. Only 20% of the protecting glass bulbs were broken. So, in contrast to our belief, 80% of the light bulbs kept working normally under water.

As seen on the filament from the crashed car, a deep blue color oxidation and small rounded cavities were observed on the tested filament using the three light bulbs that did not resist the contact with water (Figs. 6 and 7). However, tungsten excrescences were visible between spires of the test filament coils (Fig. 8). This was not the case of the broken light bulb submitted to the laboratory. In fact, these fragile growths covered with mud and so totally masked might not have resisted our ultrasound treatment. This hypothesis was confirmed by testing the effect of ultrasound treatment on one of the three broken bulbs.

FIG. 1—*The Renault car involved, after its removal from the gravel pit.*

FIG. 2—*H4 type bulb from the broken optical set, before the final cleaning with ultrasounds.*

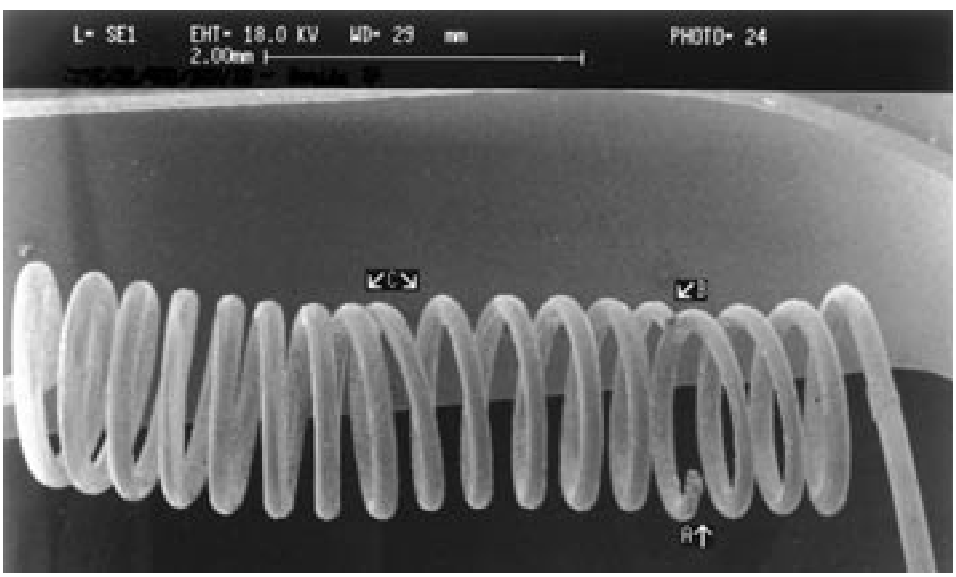

FIG. 3—*Low beam filament (SEM) showing two fractures (A,B) and a relatively weak deformation (C).*

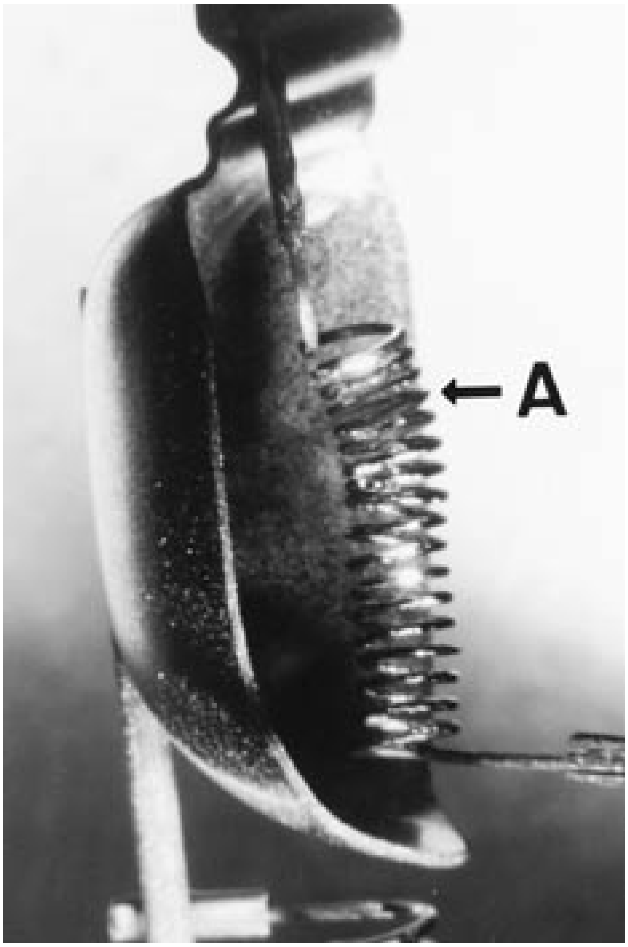

FIG. 4—*Deep blue color oxidation (A) on the low beam filament.*

FIG. 5—*Ductile type fractures and rounded cavities on the low beam filament, view by S.E.M.*

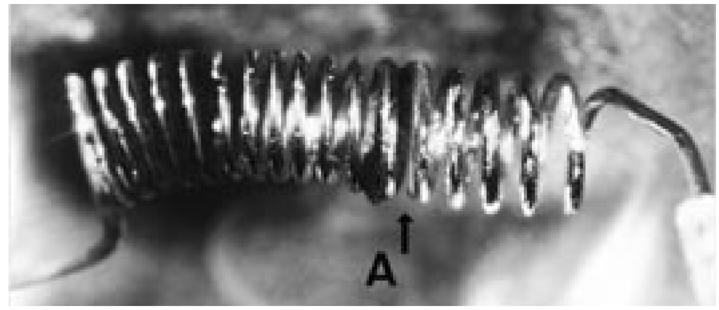

FIG. 6—*Deep blue color oxidation (A) on one of the test filament coils.*

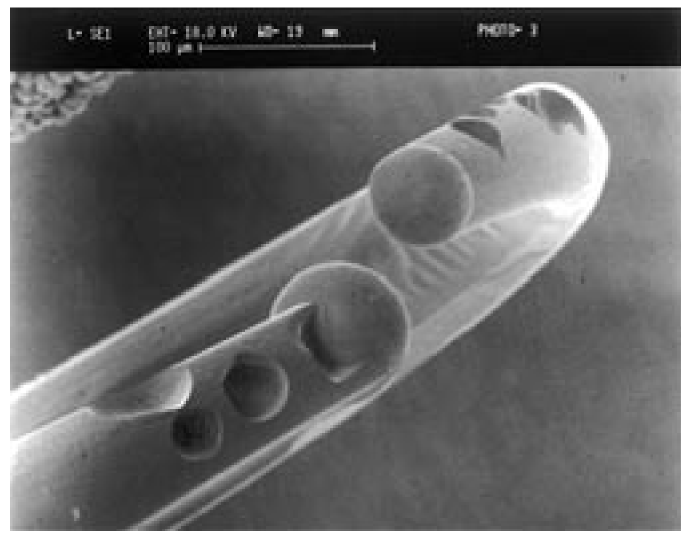

FIG. 7—*Ductile type fractures and rounded cavities on one of the test filament coils, view by S.E.M.*

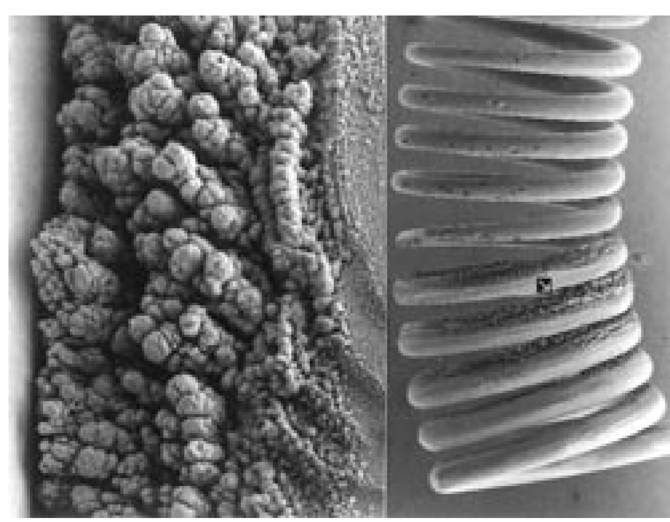

FIG. 8—*Tungsten excrescences between spires of the test filament coil.*

Conclusion

The first supposition of the investigators was erroneous. That the first light bulb was intact did not prove that it was not working when the vehicle fell into the water of the gravel pit. In fact, H4 type light bulbs have a protective bulb of toughened quartz type, which makes them particularly resistant to thermal shocks. Hence, in the present case, we were unable to determine whether or not this light bulb was working during the crash dive.

On the contrary, the second light bulb allowed us to conclude that the low beam filament was working when the vehicle fell into the water. The filament coil showed ductile type fractures and a very special type of oxidation, which could only be reproduced by keeping a filament working in water and not in atmosphere.

In this case, only a perfect knowledge of the police investigations allowed the expert to proceed to necessary simulations. These tests were compulsory to give a clear conclusion.

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References

1. Thorsen KA. Forensic examination of bulb by SEM. Electron microscopy in forensic, occupational and environmental health sciences. New York, NY: Plenum Press, 1986;117–47.
2. Baker JS, Lindquist TH. Lamp examination for on or off in traffic accidents. Traffic Institute, Northwestern University, Evanston, IL, 1972.
3. Mathyer J. Evidence obtained from the examination of incandescent electric lamps: particularly lamps of vehicles involved in road accidents. Int Criminal Police Revi 1975;29:288 and 1975;29:34–41.
4. Baudoin P, Lavabre R. A particular case of oxidation colors on bulb filament after a car crash. J Forensic Sci 1996;41(2):304–9.
5. Thorsen KA. Examination of bulb filaments by scanning electron microscope. Royal Can Mounted Police Gaz 1980;42(11):9–16;Can Soc Forensic Sci J 1981;14(2):55.
6. Goebel R. Examination of incandescent bulbs of motor vehicles after road accidents. Scanning electron microscopy, Part II, 1975;547–54.

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