Frontier Analysis, Ltd.

TECHNICAL SERVICE RESPONSE NO.: UT011

Subject: Analysis of Residue That Resulted After an Unknown Basketball-Size Object Impacted a Car

Date: April 6, 2001

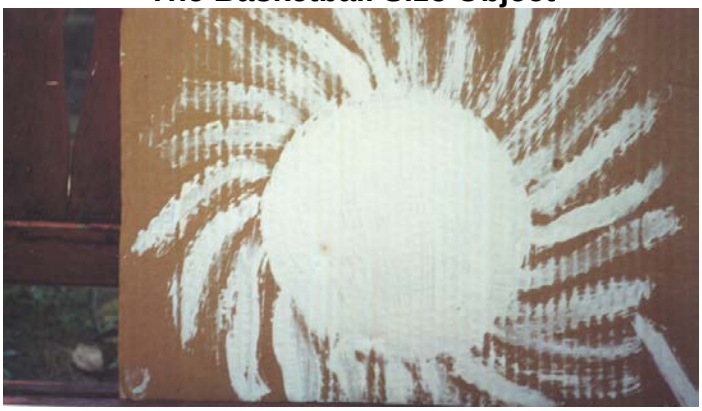
Requested By: Harold Marquardt
Mt. Clemens, Michigan

John Timmerman
CUFOS Treasurer
Lima, Ohio

Reported By: P. A. Budinger
Analytical Scientist

Background/Objective: On November 27, 1998 between 7:00 – 7:30 p.m. a driver "Shirley" was driving east on 25 Mile road (six miles north of Mt. Clemens, Michigan). It was just getting dark and she noticed a highly intense, white, basketball sized light/object rapidly coming toward her. There was no sound, and it hit the car with a slight thump or bang. It is unknown what happened to the object after the impact. A cream/gray colored residue was observed where the impact occurred. The object is to identify the residue. It is a 1992 Ford Escort station wagon with a 1.9 l engine. Recently, the car was examined. There is no evidence of the impact on the car, i.e. no residue remained, and there was no dent. Following are photographs of a drawing by the driver of the object and the residue left on the car soon after the event.

The Basketball Size Object



Residue on the Car

Conclusions:

1.) Metal oxide, silicate mineral (a kaolinite type), a celluloidal material and indications of a trace amount of natural ester are found in the cream/gray colored residue on the car. There is a very high probability the metal oxide originates from the object. (It does not appear to be a common type used in paint formulations.) The celluloidal material could also be from the object. Though it should be noted that a modified celluloidal material (specifically cellulose acetate butyrate - CAB) is commonly used as a filler in paint. This material is not chemically modified; it appears to be of natural plant origin. This speculation is fortified by the indicated presence of a natural ester. The silicate source remains unclear. However, some types are known to be used as additives in paint. (Without knowing the specifications of the paint used in a 1992 Ford Escort) we cannot be sure of its origin. However, this analyst feels the silicate is related to the object. Components of the finish/paint are also detected, i.e. an acrylate/styrene/urethane polymer coat (probably the clear coat) and an epoxy layer which probably contains the red pigment. Additionally detected in trace amounts are materials thought to contaminate the sample, e.g. skin fragment and a styrene/isoprene polymer.

2.) Lack of degradation of the paint and the celluloidal material, as well as hydration of the inorganics (silicate mineral and/or metal oxide) indicates little, if any, heat was transferred during the very brief contact with the object. Furthermore, it can be speculated that the object itself was not hot **if** the aforementioned materials transferred to the car because of the same reasons. If the object was hot the celluloidal material would have incinerated and the inorganics would not be hydrated.

3.) A dull thud on impact, and the fact that the car was not dented, suggests the object was of low mass. A bolide/meteorite would be expected to leave a sizable dent (Note: the area impact at this date (two years later) is clear of the residue and also shows no damage to the paint.)[1]

4.)The fact that the object impacted the car would suggest it was not under control.

[1] As I understand the car has remained unwashed and unwaxed.

5.) While the object still remains unidentified, a clue to the its origin/purpose may be indicated by the substance which resulted from the impact. The metal oxide is speculated to be part of the object. The possible transferal of silicate mineral and/or the celluloidal material from the object to the car may suggest where the object originated. Perhaps it was a field or pond.

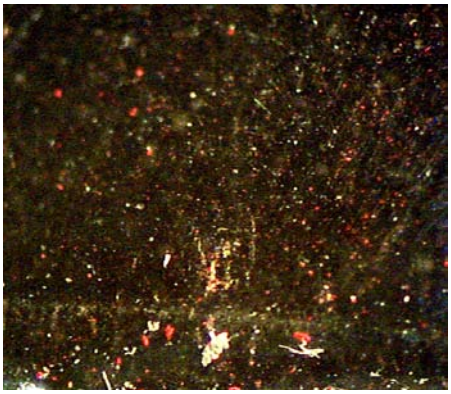
Procedure:

Sample: A sample of scrapings from the impact area of the car was submitted wrapped in polyethylene plastic wrap. There was an extremely small amount of material to work with (probably less than 2 milligrams). It consisted of a mixture of red and cream and gray colored particulates.

Infrared spectra were obtained of both the red and cream-gray colored particulates using the Harrick SplitPea® cell on the Nicolet Avatar 360 spectrometer. Additionally, infrared microscope spectra were obtained using a microscope interfaced to a Nicolet SX 60 spectrometer[2]. Microscope photographs were also taken of the sample using the Leika GZ6 stereomicroscope interfaced to a Kodak Digital Science MDS 120 camera. Due to the small amount of sample available further testing could not be performed. Additional SEM/EDS elemental data would have been extremely beneficial to this analysis.

Results:

Microscope pictures of the particulates follow. The red particulates are paint from the car. The cream colored material is residue resulting from impact with the unknown object. The particulates were less than one mm in size, i.e. in the micron ranges.



Numerous infrared spectra were obtained from the assorted particulates. Following is a table listing of the various components found. The most representative spectrum of each component is also attached in the figures included at the end of this report.

[2] This analyst wishes to express acknowledgment and thanks to the Ferro Corporation for use of their instrumentation.

Spectrum	Identification	Spectrum Figures
Cream - Gray Colored Material	The spectra show indications of a mixture of silicate mineral (kaolinite, an aluminum silicate) and a metal oxide. One or both the inorganics (silicate and metal oxide) appear to be hydrated. These materials are in the presence of the car finish layers, i.e. epoxy resin based on bisphenol A and residual methyl methacrylate/styrene/urethane. Computer massaging of the data to remove paint interference enhances the mineral absorption for one spectrum (Fig. 2) which is also shown. (Five spectra contain evidence of this material.) A kaolinite reference (Fig. 3) is also included for comparison.	1, 2, 3
Gray Particles	These spectra identify celluloidal material and long chain ester material speculated to be natural ester. (Three different spectra showed these materials.)	4
Red Chip	These spectra are obviously of paint and were taken for reference. It shows a methyl methacrylate/styrene/urethane enamel type coating. It is speculated to belong to the outer clear coat finish layer of the car. (Two spectra were obtained of this material.)	5
Gray Material	The spectrum identifies styrene/isoprene and possible celluloidal material. The styrene/isoprene is suspected to be a contaminant. (Only one microscope/infrared spectrum was obtained.)	*
Gray Material	This spectrum shows a protein amide type material. It is most likely a skin flake contaminant. (One microscope/infrared spectrum was acquired.)	*

*These spectra were obtained with another instrument (Nicolet SX60 interfaced to a microscope). The spectra do not copy well in the report. They are filed and Xerox spectra can be supplied if desired.

A summary of the above table follows. It basically shows that the prominent components of the sample submitted are from the car finish polymers, kaolin mineral (an aluminum silicate), celluloidal material, and metal oxide. A small amount of natural ester may be present. The remaining protein amide material and styrene/isoprene are in very minor amounts and are most likely sample contaminants.

Car finishes are composed of multi-layers. These coating layers, as noted above, are detected along with the cream colored residue. The epoxy resin detected is probably the primer layer, and the methyl methacrylate/styrene/urethane polymer is the clear coat[3]. The exact paint formulation for the 1992 Ford Escort is at present unknown. This information is

[3] http://www.nationaldetail.com/tips/xtra.html; Also, I would like to thank and acknowledge Ray Lukco, chemist for a well-known and prominent coatings manufacturer for pertinent information on car finishes.

usually classified but the above materials are commonly used in original equipment manufacturer (OEM) finishes[4].

Additives are sometimes used in car finishes such as a chemically modified celluloidal material, e.g. CAB (cellulose acetate butyrate). However, the celluloidal material found in this analysis is not CAB. It is not chemically modified. So it could possibly be from a natural plant origin. The indicated presence of a small amount of natural ester would support this speculation. The silicate (kaolinite mineral) could also be used as an additive to give color to the metallic flakes. Accordingly, the source of this material cannot be established with any assurance. Therefore, probably the celluloidal material, and maybe the silicate mineral, could be a result of the impact. These components could possibly originate from "dirt"/soil and plant debris. This may be a clue to the object's origin.

The metal oxide is not specifically identified. It has spectral bands closest to manganese oxide. Clearly it is not aluminum oxide[5]. Unfortunately, there was not enough sample to submit for SEM/EDS elemental analysis in order to identify the specific oxide type. Another possibility could be iron oxide red pigment. This is probably the most likely source **if** a metal oxide originated from the finish. However, the color of the residue from which the spectra were obtained was cream/gray colored. Therefore, because the oxide is not aluminum oxide or red iron oxide (pigment), the finish is most likely **not** a source of this material. It is speculated to be a part of the unknown object.

Lack of degradation of the paint components and the celluloidal material shows little, if any, heat was transferred during contact with the object. Also, the silicate mineral and/or metal oxide seem hydrated, which suggests no significant heat was involved. Furthermore, one could also speculate that the object itself is indicated to be cool because of the possibility that the celluloidal material and hydrated inorganics were transported on or are part the object. If the object were hot, the celluloidal material would be incinerated and there would little, if any, hydration of the inorganics.

A dull thud on impact, and the fact that the car was not dented, suggests the object was of low mass. A bolide or meteorite would be expected to leave a sizable dent (Note: the area impact at this date (two years later) is clear of the residue and also shows no damage to the paint.)[6]

And finally, the fact that the object impacted the car would suggest that it was not under control.

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Distribution:
Ted Phillips
Nancy Talbott
Ray Lukco

_____
Phyllis A. Budinger

[4] It is assumed the paint is an OEM finish, i.e. the car was not a vehicle refinish (VR).
[5] Aluminum metal flakes are often used in paints to give the shimmering appearance.
[6] As I understand the car has remained unwashed and unwaxed.

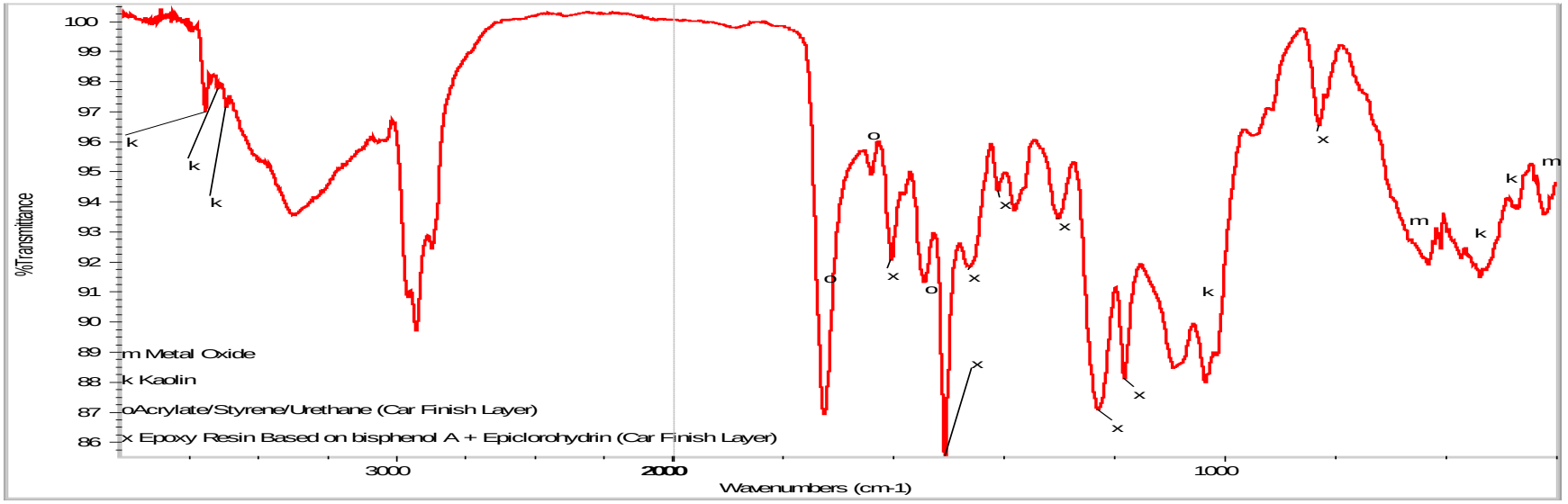

Figure 1. Infrared spectrum of cream/gray colored impact residue.

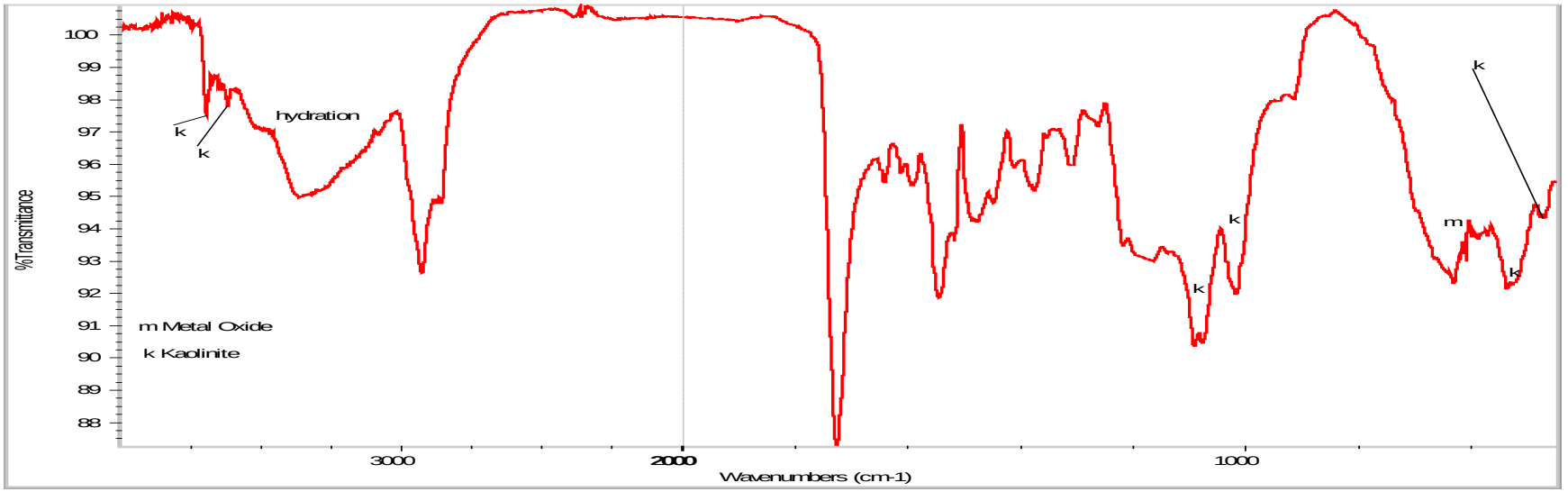

Figure 2. Infrared spectrum with paint interference removed.

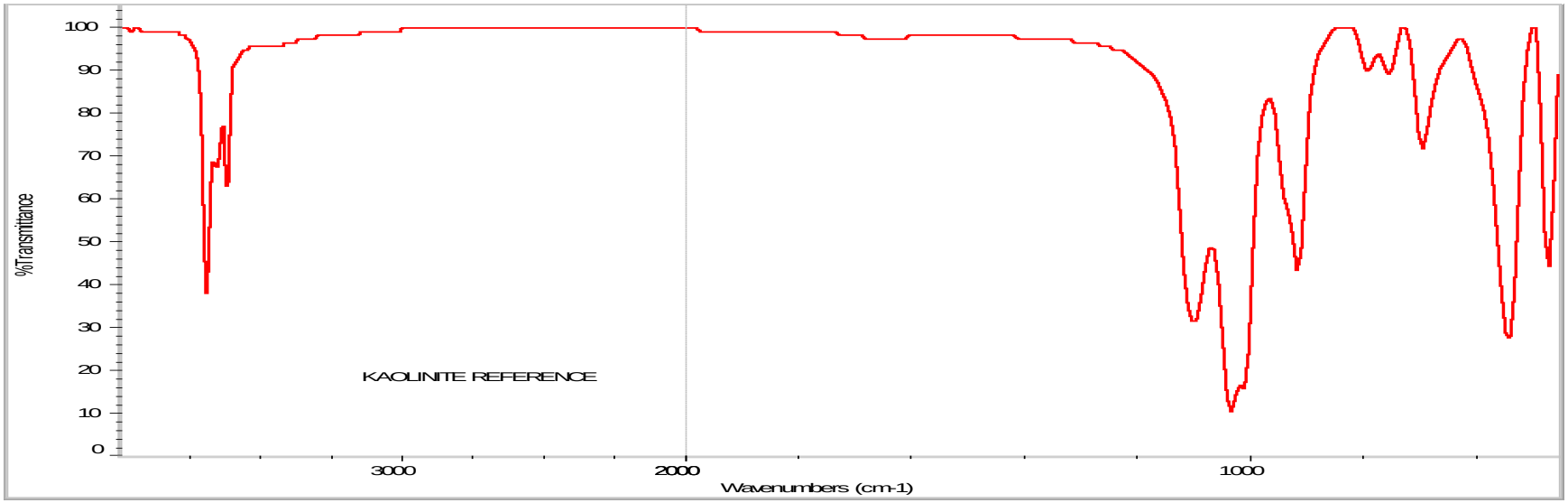

Figure 3. Infrared reference spectrum of a silicate mineral, specifically kaolinite – an aluminum silicate.

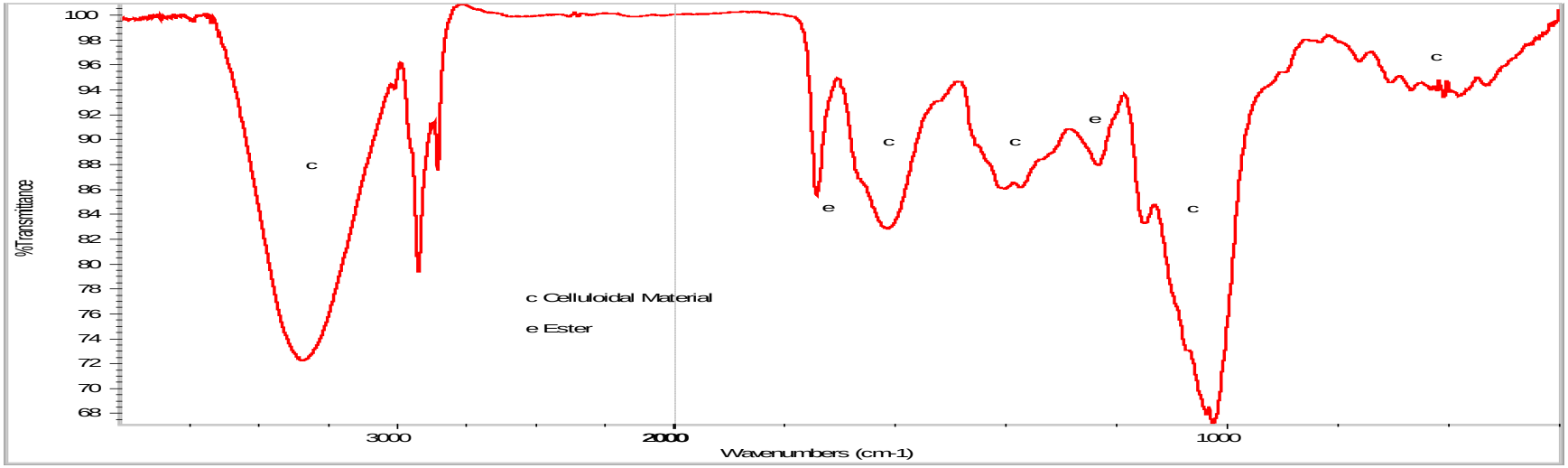

Figure 4. Infrared spectrum of gray particles from the impact residue.

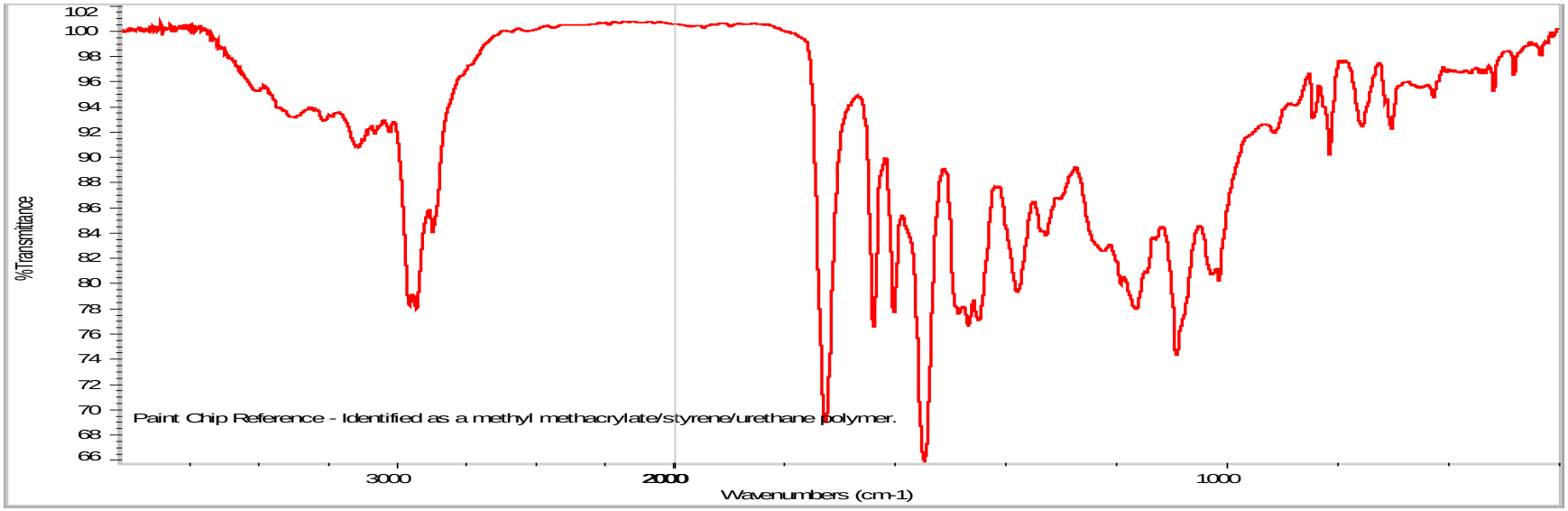

Figure 5. Infrared spectrum of a red paint chip from the car.