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The Application of Wax Laps to Vibratory Polishers*†

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INTRODUCTION

The literature concerning metallographic sample preparation contains descriptions of many and varied methods. Metallographers often find that a preparation technique that is satisfactory to one individual is not satisfactory to another. This is the metallographic art, the human element. The last two decades have produced several polishing procedures which have helped reduce this human element. One of these methods is mechanical polishing by the vibratory polisher.

The use of laps for preserving edges, inclusions and flat surfaces has been known for many years. The lead lap is probably the best known example but is laborious to prepare. The wax lap method for rotating polishing wheels was reported by Schaeffler[1] in 1944. This method has never gained wide acceptance among metallographers.

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† To be presented at the 16th Meeting of the United States Atomic Energy Commission Metallographic Group, March 28-29, 1962, in Richland, Washington.

1 Anton L. Schaeffler: "Rapid Hand Polishing of Micro Specimens", Metal Progress, vol. 46, pp. 285-287.

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Wax laps have been used successfully on rotating wheels in our laboratory for some time. In this paper the adaptation of the wax lap surface to the vibratory polisher is described. The wax lap requires little maintenance during the life of the lap. It is not necessary to remove any of the holding devices on the bowl to clean and recondition the lap. The bowl is merely washed out, recharged and placed in operation. The wax lap will not wrinkle or tear, nor is it necessary to change it each day such as the silk or nylon cloths.

One of the most promising aspects of a wax lap is the ability to maintain specimen edges during long periods of polishing. Maintaining flatness to the edge of the specimen is difficult by polishing on rotating cloth covered wheels. Wax laps avoid this problem since the specimen may be polished as long as necessary to obtain a fine surface preparation while still preserving the specimen edges and flatness. Often the metallographer wishes to study inclusions as an integral part of the examination. These are often difficult to retain in their true sizes and shapes. The wax lap will retain inclusions with no evidence of pitting or rounding, and again the time of polishing is not critical.

PROCEDURE

Wax lap preparation for the vibratory polisher is quick and simple. The wax is melted, poured into the bowl and allowed to solidify. As soon as the wax surface begins solidifying, cold water may be used to hasten cooling to room temperature. There is no necessity for preparation of the bowl prior to casting of the wax. The wax adheres to the bowl without difficulty. The wax used in this laboratory is A-B Uniwax, a Buehler Ltd. product.

Specimens to be polished on the wax lap were mounted in bakelite or lucite. The specimens were ground using successively finer silicon carbide papers, normally finishing with 600 grit abrasive, and cleaned in an ultrasonic cleaner. Specimen mounts were clamped in the conventional holders used with the vibratory polisher. The vibratory polisher equipped with the wax lap was used with Linde A abrasive. It was found that a small quantity of liquid detergent (Vel) was very beneficial in preventing the pick-up of wax on the specimen. Polishing was continued until only fine scratches were visible at 100 diameters. The samples were then transferred to a micro cloth covered bowl using Linde B abrasive for final polishing. This final polish was kept short to minimize pitting and edge rounding. Specimens were cleaned ultrasonically and examined.

The time required to polish on the wax lap varies from a few minutes to several hours depending on the hardness of the material. The times seem to be approximately the same as those used with cloth on the vibratory polisher. However, a complete and quantitative comparison has not been made. The time for the final polish on the cloth is usually less than one-half hour.

Our present wax lap has been in operation for over nine months and is not in need of replacement. After every polishing cycle the bowl was washed in warm water providing a clean surface each time the wax was used. After several weeks a shallow groove will have formed at the periphery of the bowl. This can be removed by melting the surface of the wax with hot water and allowing it to solidify again.

RESULTS

Photomicrographs of typical metals and alloys studied in this laboratory are shown in Figures 1 through 20. All specimens have been mechanically polished on a Syntron vibratory polisher equipped with a wax lap and Linde "A" abrasive. The specimens have also been given a final polish for a short period of time on a Syntron polisher equipped with a micro cloth and Linde "B" abrasive.

CONCLUSIONS

The metallographic art is becoming a science. The vibratory polisher is one device that is speeding this transformation. By combining new ideas with some of the worthwhile older methods we can create a more scientific atmosphere in the field of metallography. The wax lap adapted to the vibratory polisher is one example. There are many other methods and ideas which need investigation.

Figure 1. Nickel 150x
Etch: HNO_3-$C_2H_6O_2$

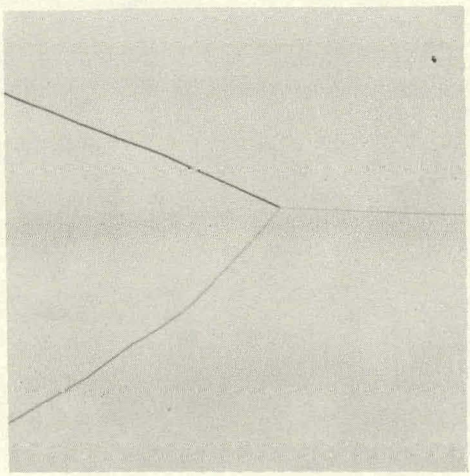

Figure 2. Chromium 150x
Etch: Oxalic Acid

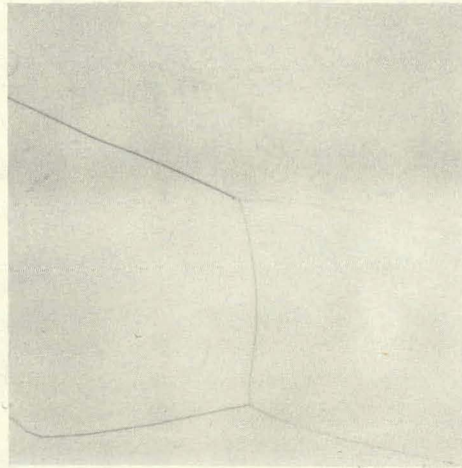

Figure 3. Niobium 150x
Etch: $HF-HNO_3-H_2SO_4$

Figure 4. Molybdenum 150x
Etch: Murakami's

Figure 5. Manganese 150x
Etch: Nital

Figure 6. Grey Cast Iron
750x. As Polished

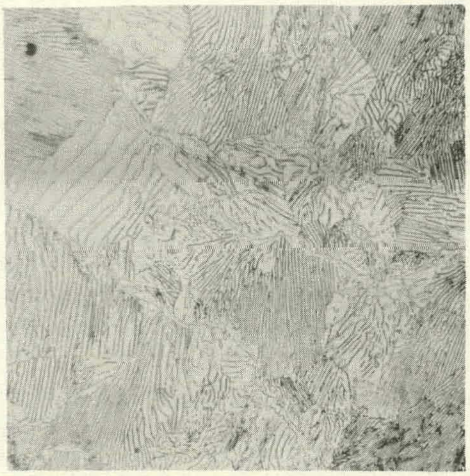

Figure 7. 1090 Steel 450x
Etch: Nital

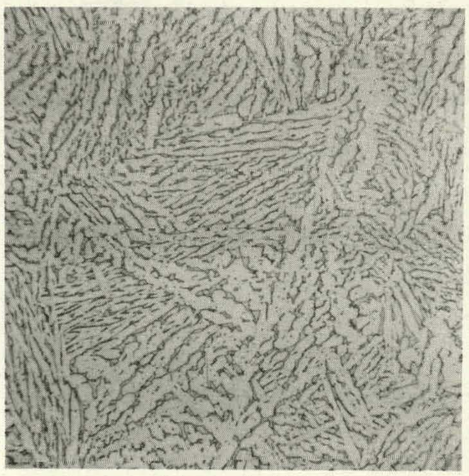

Figure 8. 60-40 Brass
150x Etch: Alcoholic $FeCl_3$

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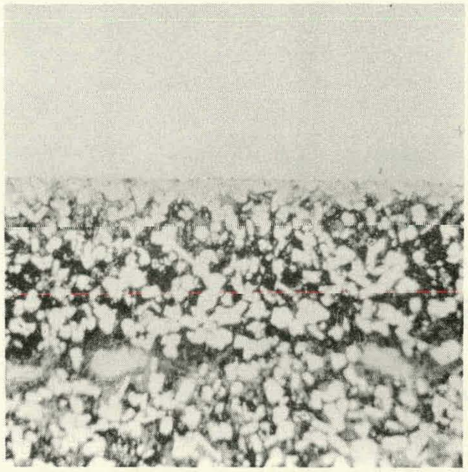

Figure 9. Uranium-Chromium in Niobium Crucible 250x
Etch: Oxalic Acid

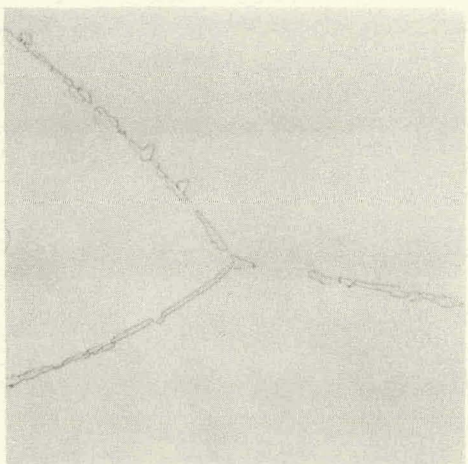

Figure 10. Niobium with $6\% \; O_2$ 750x, As Polished

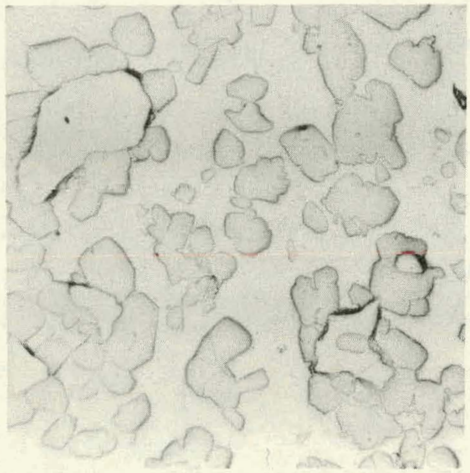

Figure 11. Niobium with Oxide Layer 450x, As Polished

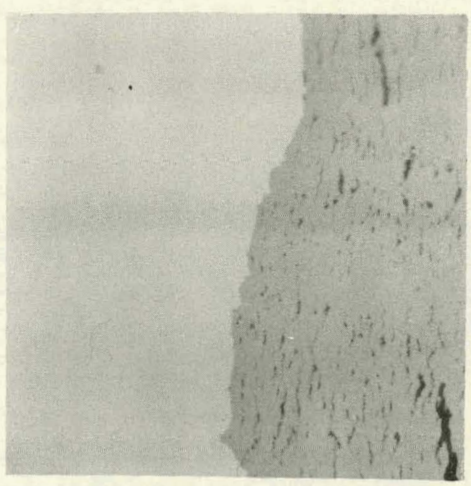

Figure 12. Intermetallic Niobium-Tin Embedded in Tin Matrix 100x, As Polished

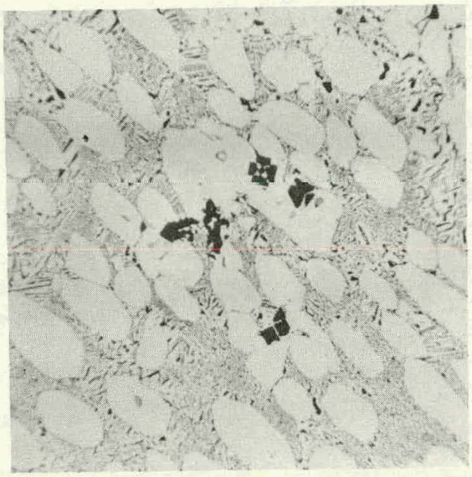

Figure 13. 94 w/o Uranium-Manganese 150x. Etch: Oxalic Acid

Figure 14. 89.5 w/o Uranium-Nickel 150x. Etch: Oxalic Acid

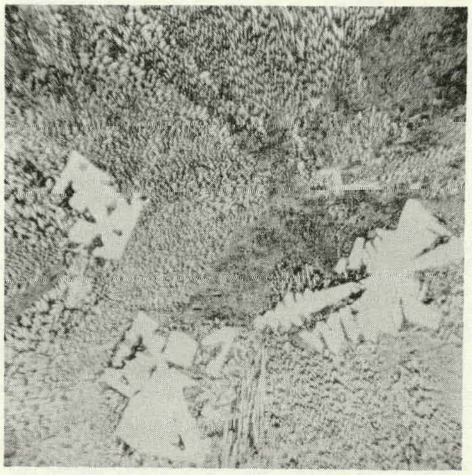

Figure 15. 88.3 w/o Uranium-Iron 150x. Etch: Oxalic Acid

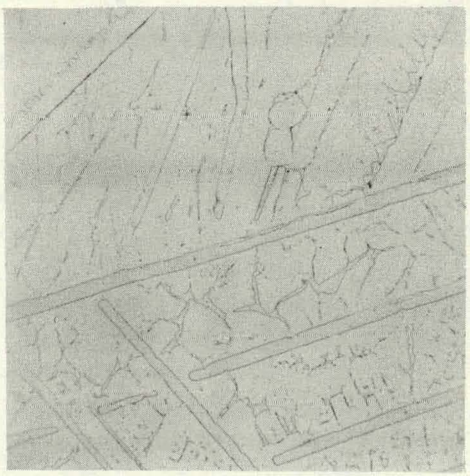

Figure 16. 44 w/o Nickel-Zirconium 150x. Etch: HF-HNO_3-glycerine

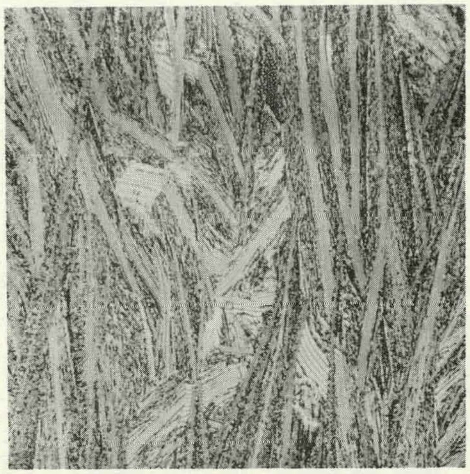

Figure 17. 42.5 w/o Cobalt-Zirconium 950x. Etch: HF-HNO_3- glycerine

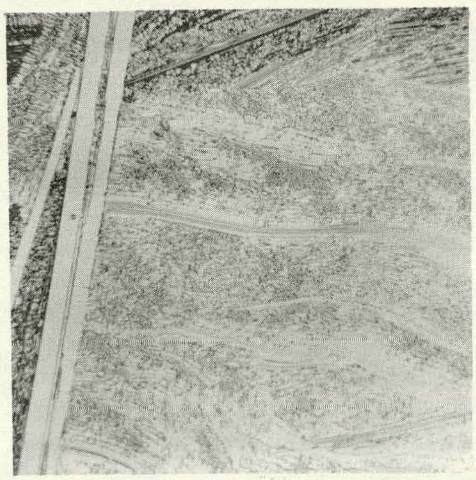

Figure 18. 86 w/o Cobalt-Zirconium 450x. Etch: HF-HNO_3-glycerine

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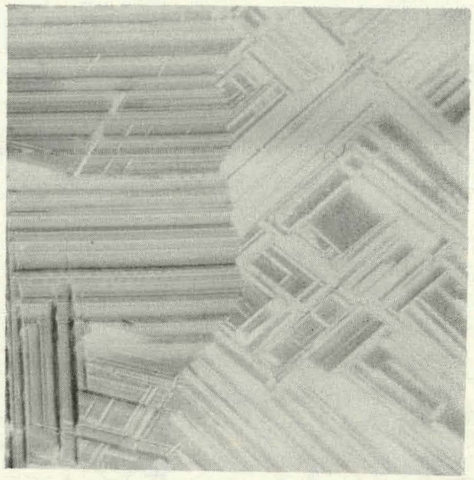

Figure 19. Vanadium Carbide 150x. Etch: HF-HNO_3-glycerine

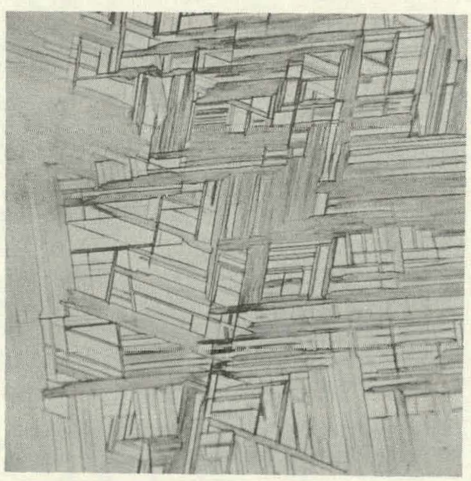

Figure 20. Tantalum Carbide 950x. Etch: HF-HNO_3-H_2SO_4

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