"Repairing A Pit in Jewelry Without using Heat or Laser"

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Abstract

This paper will discuss one of the most common problems jewelers are faced with Porosity. And a new technique that explores a way of repairing these pits without using laser or heat. The mechanical bonding technique.

Key Words

Porosity, Repairing, Cold Welding, Mechanical bonding, burnishing, polishing, undercutting, inlay.

Due to new developments in laser technology, laser is recognized to be the best way to repair porosity due to the fact that you can adjust and direct the laser beam with pinpoint accuracy and not cause any further damage to the piece. Since there is no heat build up, repairs can be done around stones, without compromising any, or around any tension or spring devices that would be ruined with the introduction of heat. However, this laser process is not readily accessible to most jewelers at this time.

Flame welding continues to be the second best way. The drawback to this technique is the use of heat which could cause more problems, such as; porosity or it could destroy any stones already set.

Here is two typical scenarios that jeweler's might encounter: The first one is of a jeweler just finishing up a beautiful emerald and diamond ring set in 18K yellow gold. The diamonds are set, the emeralds are set, and the final polish is well under way when a pit shows up only millimeters away from the emerald. Upon further examination this jeweler realizes he can't use heat because of the emerald and doesn't have access to a laser.

The second scenario is of a jeweler who has taken extra precautions while making a platinum and diamond ring, by pre-polishing most of the pieces to be assembled, and has set the diamonds. This jeweler then begins the final polish, at which time a pit shows up. He to doesn't have access to a laser.

Both jewelers in these scenarios are facing a different set of problems. The first jeweler with the emerald and diamond ring can't use heat due to the fragility of the emerald and the proximity of the pit to the stone. The second jeweler can't use the heat required for platinum welding because of the presence of the diamonds. So what are their options at this point?

The options might include:

- Remaking the ring
- Leaving the pit and compromising quality.
- Burnishing the pit and re-polishing if the pit isn't to large.
- Using solder to repair the pit (which is unacceptable).
- **Repair pit using the mechanical bonding technique**.

To lay the basis for this technique let's review the welding procedures that are recognized by the American Welding Society.

1. Coextrusion Welding
2. Cold Welding
3. Diffusion Welding
4. Explosion Welding
5. Forge Welding
6. Friction Welding
7. Hot pressure Welding
8. Roll Welding
9. Ultrasonic Welding.

The reason for identifying these procedures is to show that in other industries these processes have become very valuable in that they yield high results in strength and integrity. An example of this would be the cold welding of aluminum. When two pieces of aluminum are pressed together and the original thickness of the metal is reduced to approximately one-fourth of the original thickness, the aluminum when welded by his process has tensile strength of up to 22,000 psi.

Metals to be joined by cold welding must be carefully prepared. Oxides and other contaminates must be completely removed. Taking extra care that any residual solvents or chemicals have been removed or in other words, surgically clean.

The basic theory of the cold welding process is that the pressure at the surface causes fusion only a few molecules deep. The fusion is all that is needed to hold the material together and provide needed strength.

As is common knowledge there are two ways of bonding metal. Metallurgically and mechanically. What we are discussing in this paper is mechanical bonding and combines techniques from both cold welding and undercut inlay.

Traditional undercut inlay is done by cutting a shape into the surface of the piece and undercutting the perimeter. A softer alloy of same metal is then puzzle fit and hammered into shape, it spreads out and locks into the undercut. It, subsequently, can be shaped or fashioned into any desired form. This process, if desired, can be taken further using burnishing and polishing techniques to make inlaid metal disappear into itself, henceforth, not being visible to the naked eye.

Here is how the process works:

Figure 1 - We see a drawing of a ring and a pit has shown up. The ring cannot be heated due to the stone that is set.

Figure 2 - Shows the first step in repairing the pit without heat or laser. Take small round bur and drill the irregular pit so as to make a clean round hole.

Figure 3 - Shows the second step required. The depth is very important to ensure permanence of the repair. A good average depth is no less that than 60% below the surface and no more than 70% below the surface. This measurement can be achieved by examining the depth of the round bur during the cutting operation.

Figure 4 - Shows the third step. Using a smaller round bur, begin undercutting in an irregular pattern. Similar to a rounded triangle. This is necessary to ensure that new metal will lock into place permanently.

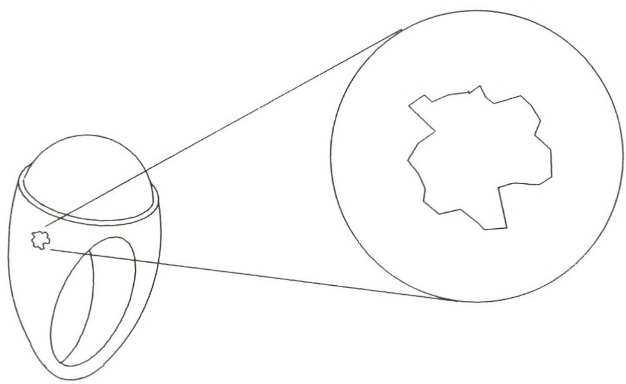

Figure 1

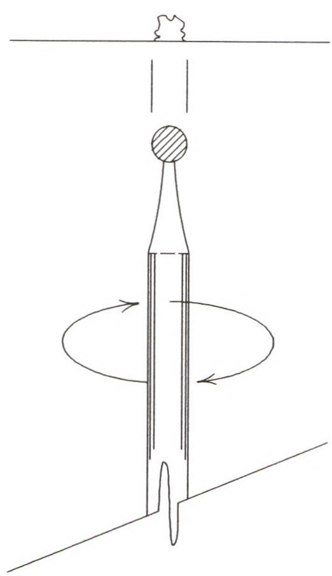

Figure 2

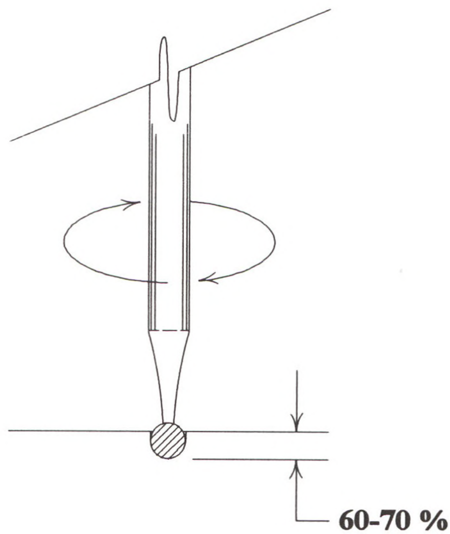

Figure 3

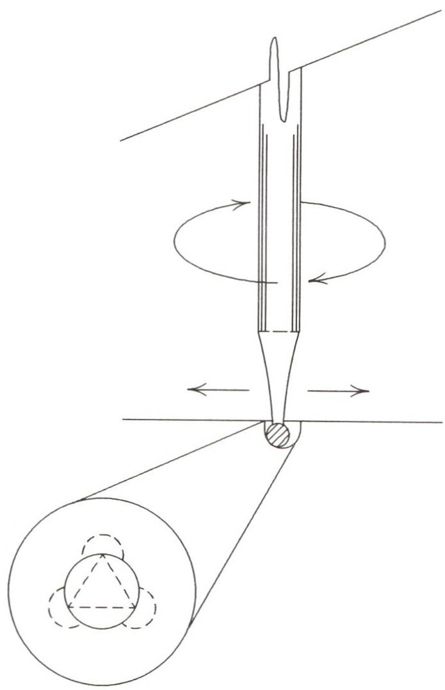

Figure 4

Figure 5 - Shows how the sides need to be undercut. This i. necessary in order to form a good solid foundation. This will help keep the metal from rotating or rocking up and down once it has been introduced into the undercut area. NOTE: Too much undercutting is not desired, due to the fact that new metal is to fill all voids under the surface.

Figure 6 and 7 - Shows new metal being introduced. By melting metal into a round or spherical shape slightly larger than the drilled surface. The easiest way to achieve this is to use a small round wire approximately .50mm. After heating the end of the wire a ball shape is formed. At this time determine correct size of metal ball. If too small, re-melt to form a larger one. Metal ball should be large enough that medium pressure or tapping with a hammer is required to affix in the hole or under surface. NOTE: In the same manner as cold welding, care must be taken to ensure cleanliness. Any oxides or other contaminates must be completely removed. Keep in mind that chemicals may introduce unwanted residual solvents.

Figure 8 - Shows the hammering process. A slightly rounded tip on the hammer point is desired to reduce noticeable under layers on the outside surface.

Some things to consider at this point:

A. Size of hammer point, this affects the amount of pressure or hardness of hammer tapping and vibration to surrounding metal and fragile stones.
B. Type of steel used. Tungsten carbide yields best results.
C. Prior to using burnisher, filing of the area to be worked on is necessary.
D. Hammer must be very clean. Care must be taken not to touch point so as not to transfer any oils from hands to the surface.

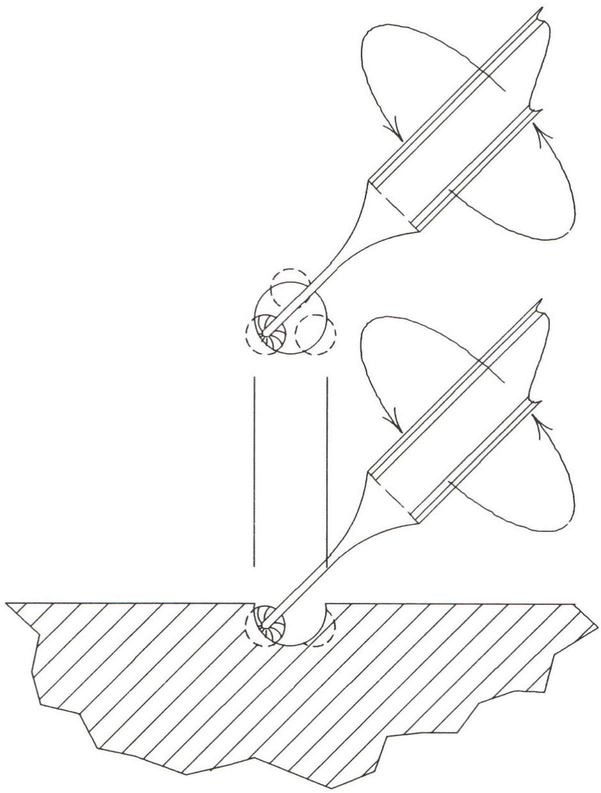

Figure 5

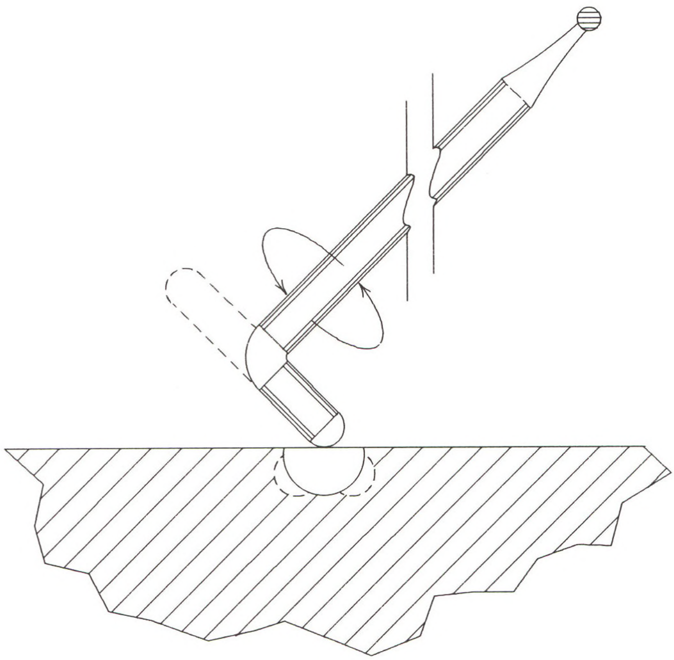

Figure 6

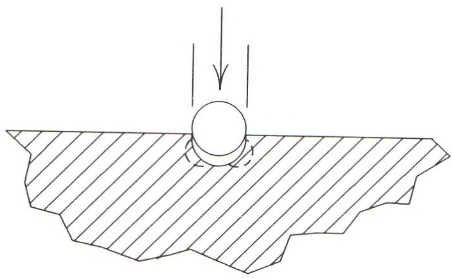

Figure 7

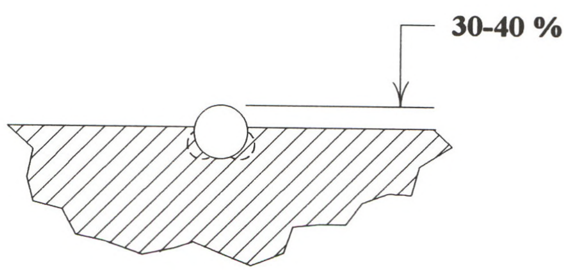

Figure 8

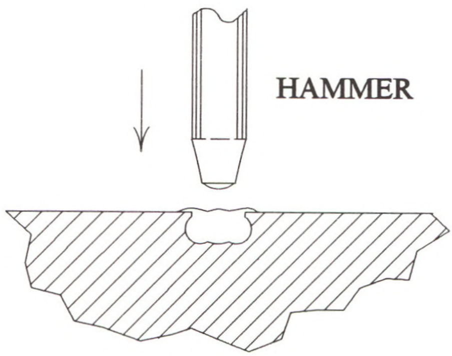

Figure 9

Figure 9 - Shows the next step. The filing of the new metal flush with original surface. After this, clean area thoroughly again. In Figure 9 the illustration shows a bur that was heated and bent 90°. The bur was then sanded to remove any fire scale and cleaned. This type of burnisher works best on gold. A tungsten carbide burnisher of like design works best for platinum. NOTE: Each type of metal should have its own burnisher to avoid cross contamination.

Figures 10 - 19 are in progressive order using the mechanical bonding technique. The top picture on each page is of a photograph taken with a Scanning Electron Microscope (SEM) at magnification 30.2X. The bottom photographs are of the same ring but in different stages of repair. Notice position of saw blade in each photo.

Conclusion:

Surface area that has been repaired using this technique, if done properly, should show no visible signs of repair. This process is permanent.

Figure 20 - Shows a cross section, using the SEM Microscope of the completed repair using this technique. The permanence of this technique can be observed in this picture.

Acknowledgments:

1. Grigory Raykhtsaum, Senior Metallurgist
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2. Johnson Matthey
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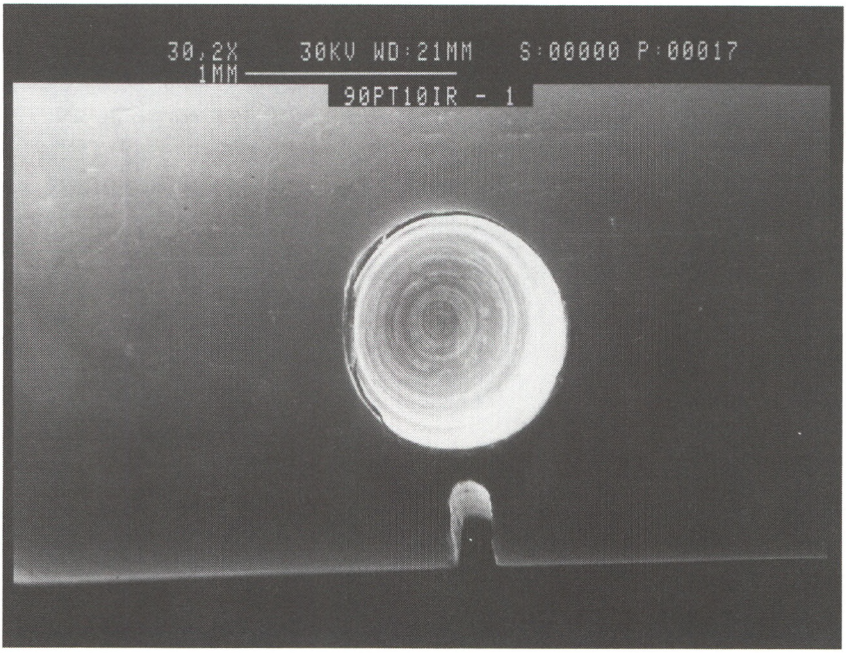

Figure 10

Figure 11

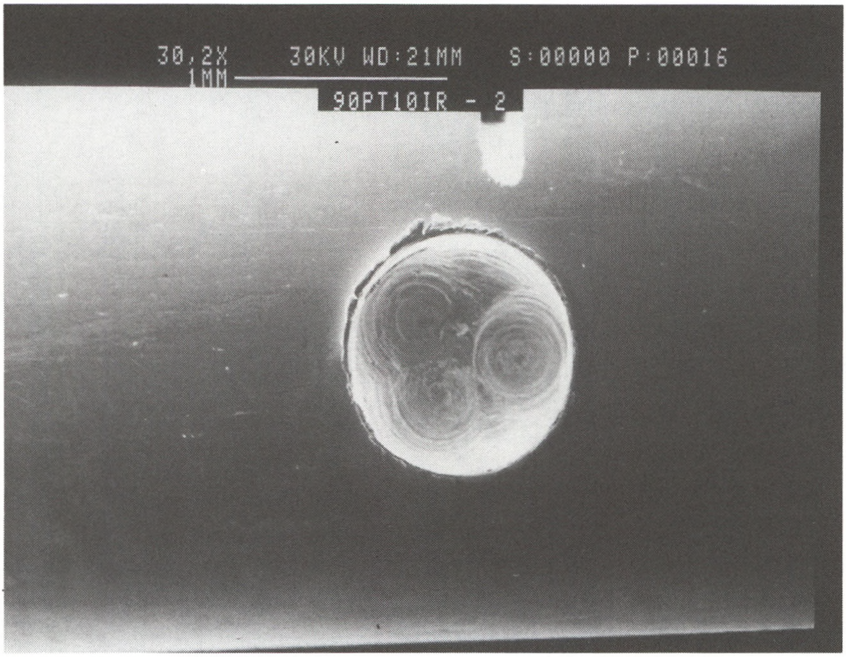

Figure 12

Figure 13

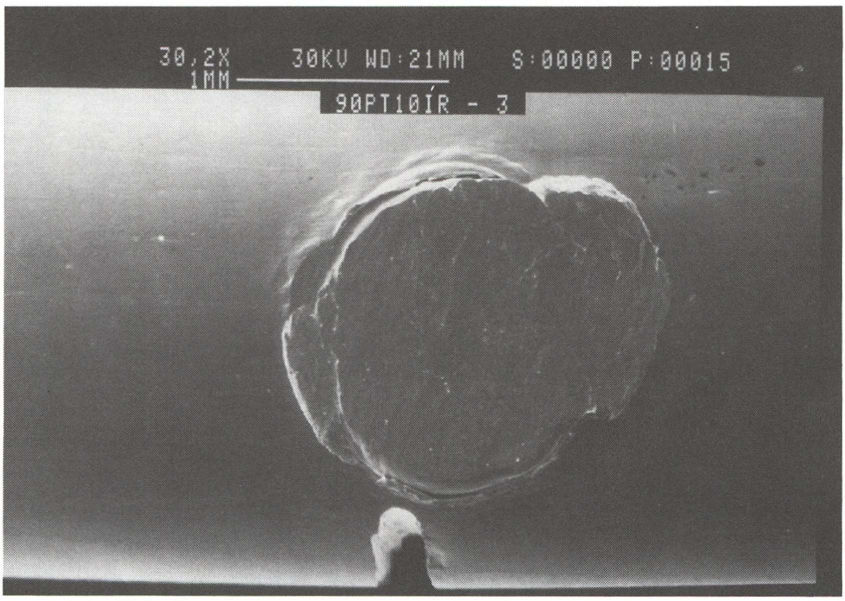

Figure 14

Figure 15

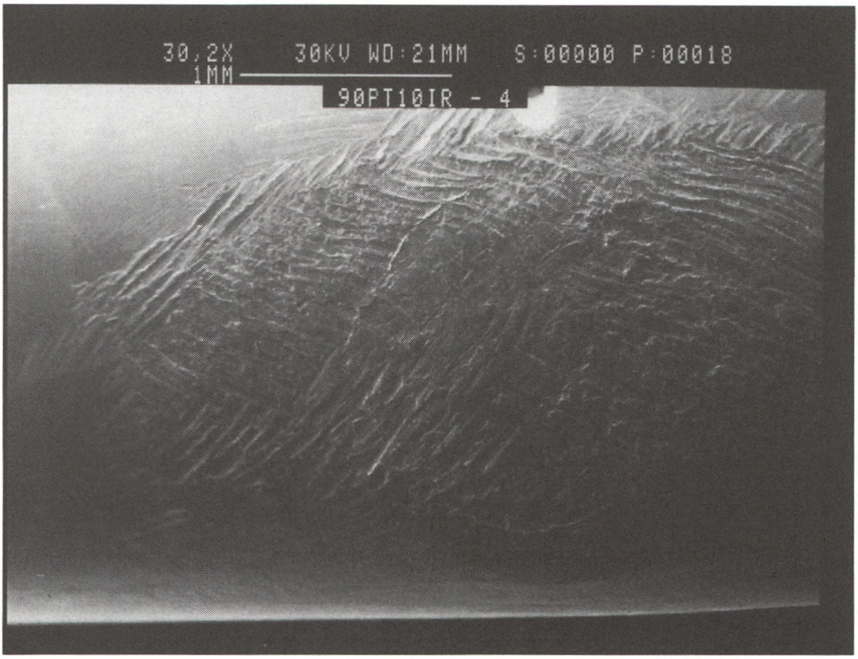

Figure 16

Figure 17

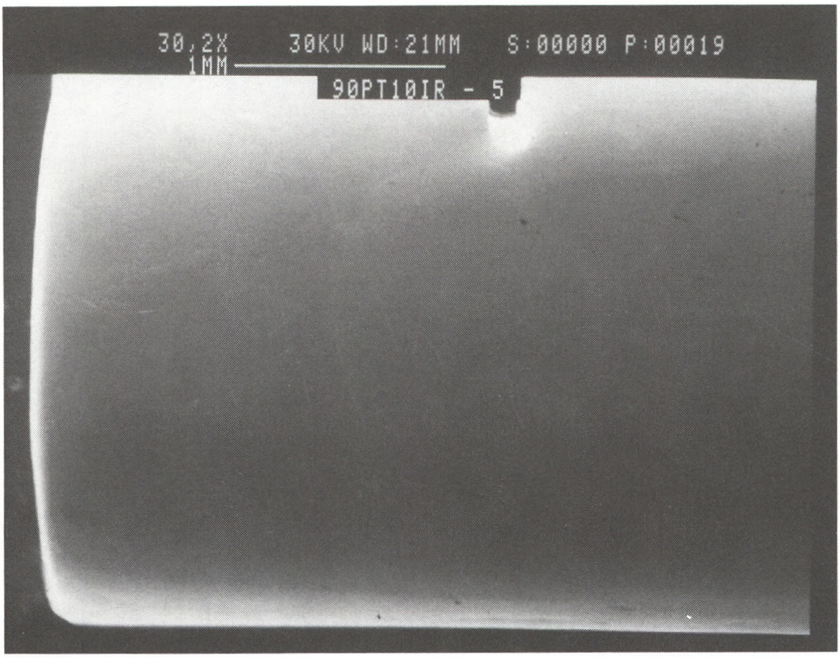

Figure 18

Figure 19

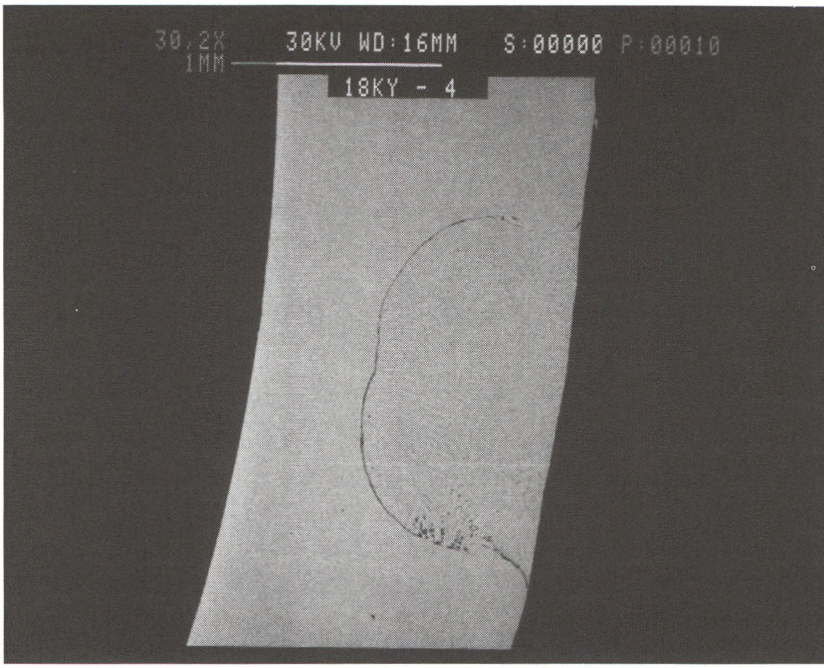

Figure 20