thin stampings and fine wire can be at least stitch welded with precision. More extensive welds and repairs of casting defects (see later section) can be made by a series of overlapping pulses. As the laser is limited to joints that can be hit by the direct beam, deep and undercut sites should be avoided.

## Jewellery Design

Several components in the jewellery shown in Figure 4 have been elastically stressed to give springiness and rigidity. The tightly localised and limited heat diffusivity allows springy and hard components to be joined with little or no softening. This enables designs that make good use of lightweight springy sections or robust fasteners. The very limited heat affected zones also allow joining of more dissimilar alloys (assay rules permitting) than would be possible with large scale melting. In good commercial practice all the components could have a high degree of finish prior to joining. Most of the high finish is preserved, and it is clearly easier before welding to clean up and polish separate components than finished pieces.

## Upgrading and Repairs

There are probably as many laser welding machines used for upgrading castings as there are for making welded pieces. Some surface defects can be repaired at the fettling stage but small pinholes sometimes show up later during polishing. The expense to both the finisher and caster of returning such components for recasting is often avoidable by using the laser welder to upgrade the castings, particularly when casting and finishing operations are on the same site.

A small area of rough surface texture may be glossed by using a rapid repeat sequence of pulses with the laser beam set relatively wide and shallow. Small pinhole defects (around 0.25 mm) can be filled by similarly pulsing around the edge of the defect. Larger defects can be effectively filled with fine filler wire touched into the defect, cut to size with the laser beam striking the wire and then levelling the filler down to the original surface. The colour of the filler can usually be matched accurately to that of the casting. The principle of relatively low thermal diffusivities of platinum jewellery alloys when used with a laser machine, whether for upgrading castings or for welding, are virtually identical.

## Conclusion

Comparing jewellery alloys, the necessary heat inputs to melt platinum alloys are high compared with gold and silver alloys, but thermal diffusivities are significantly lower. One effect is that heat is more localised around hot-spots than with gold and silver.

Most platinum jewellery alloys show the relatively high stress necessary to exceed the elastic limit, followed by a high rate of plastic work hardening which also raises the 'bend-back' stress. Components may have useful strength and springiness in slender sections, and these extra properties acquired before laser welding can be retained after assembly.

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### References

1 Rofin-Baasel UK Ltd., (formerly Baasel Lasertech UK Ltd.), Drayton Fields, Daventry, NN11 5RB

2 "Kempe's Engineers Yearbook 2000", Miller Freeman, Tonbridge, U.K., 2000

3 "CRC Handbook of Chemistry and Physics", 76th Edn., CRC, Boca Raton, 1995–1996

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## Laser Drilling of Platinum Cavities

A copper laser has been used to etch and bore into coated platinum wire electrodes (outer diameter 50–150 μm) to form ~ 30 μm diameter cavities for storing enzymes, by P. M. Vadgama of the University of Manchester (*World Appl.* 01/13,102). Cavities are formed in and along the length of the active electrode core. The enzymes face laterally, instead of being on a mechanically vulnerable tip, which improves effectiveness and ease of use. The electrodes are for *in vivo* biological sensors.