August 16, 2007

Hydrogen micro-cell

By Gennady Ananyev ananyev@princeton.edu

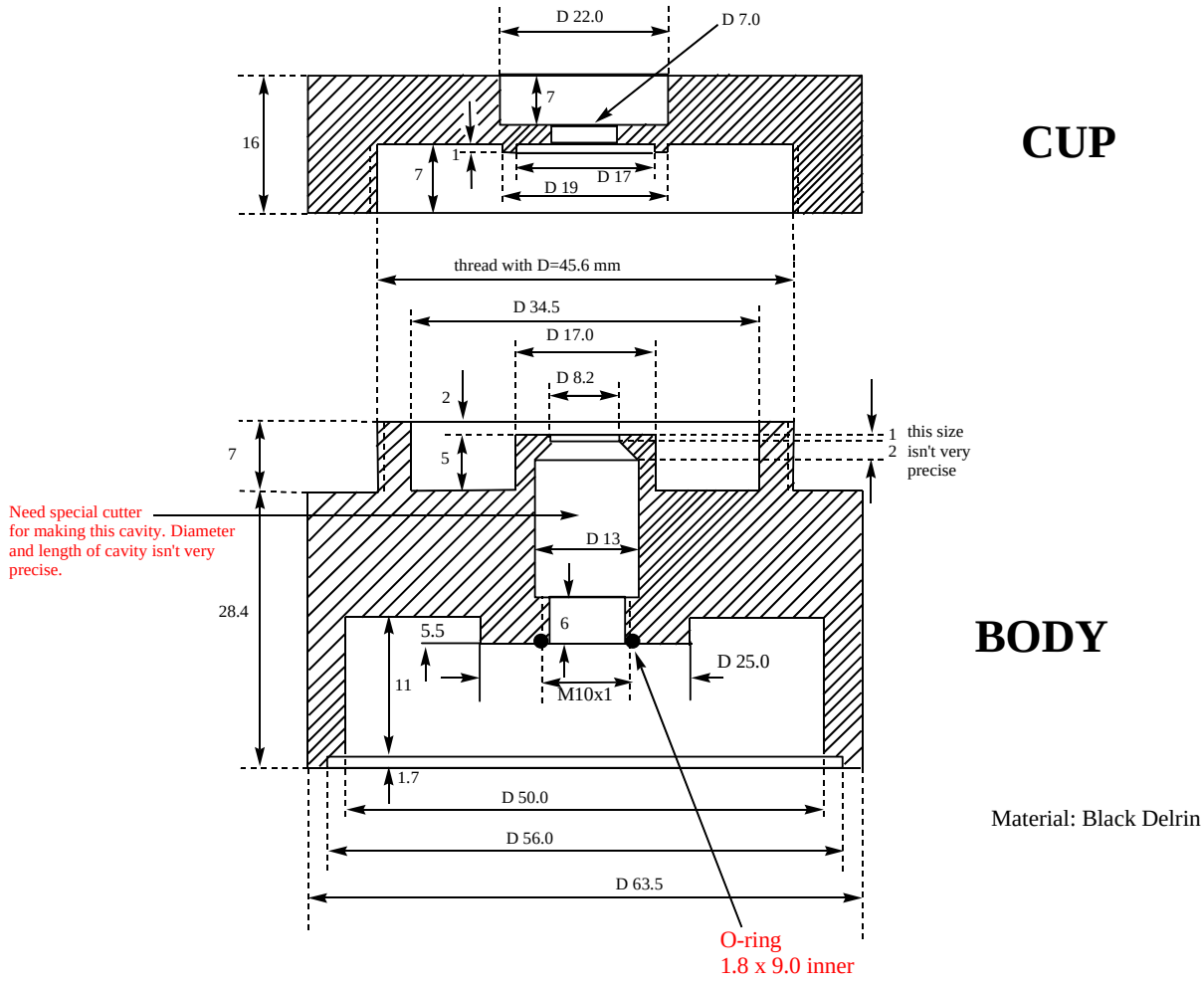
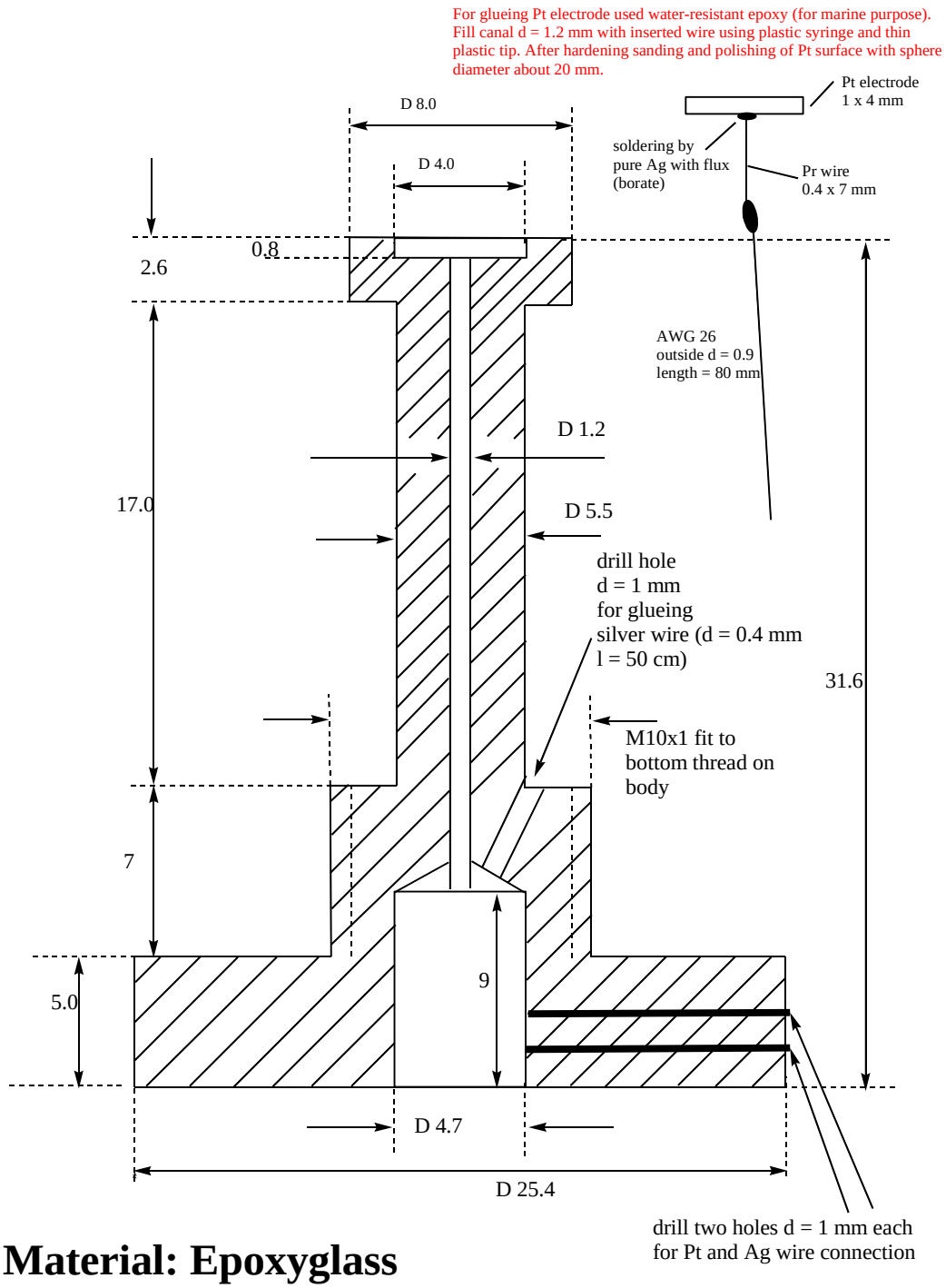
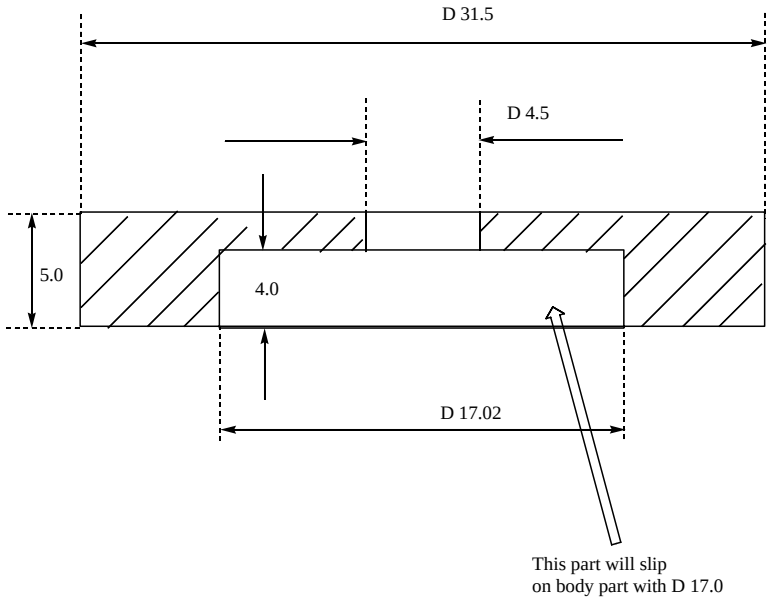


Figure 1. Body is main part of H_2 micro-cell that serves for holding electrode assembly, gas permeable membrane, Teflon ring, biological sample and cap. The cup has special hole with diameter 22.0 mm for inserting LED illuminator or UV NADH detection head. Black Delrin parts protect biological sample from ambient light.



Material: Epoxyglass

Figure 2. Electrode assembly for central Pt/Ir semi-sphere disk (mount on the top) and silver wire (length 80 cm, diameter 0.4 mm) that wrap in depression with diameter 5.5 mm. Critical issue for correct functioning whole micro-cell is shape of semi-sphere of Pt/Ir electrode and polishing with alumina oxide 1200 grits sandpaper.



Material: Teflon

Figure 3. Teflon cover ring that has three functions: (1) holds gas permeable membrane; (2) forms cavity for sample (diameter 4.5 mm, deep 0.3-0.4 mm and volume ~5 μL). On the top of Teflon ring putted quartz window (diameter 32 mm, thickness 2 mm) for protection of anaerobic biological sample from contact with air.

Some images of electrode assembly

Image 1. View of micro-cell body with inserted electrode assembly that is ready for filling by electrolyte (0.1 M KCl) and covering by gas permeable membrane (~1 μm thickness).

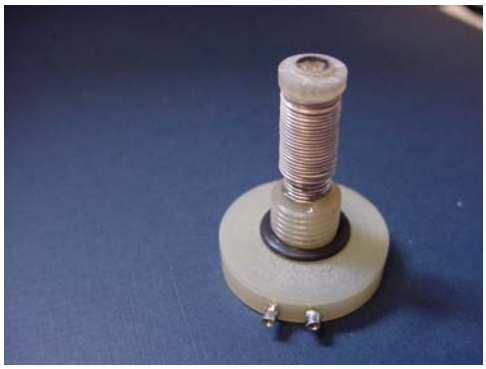


Image 2. View of electrode assembly with polished Pt/Ir electrode and wrapped silver wire.

Image 2. Side view of electrode assembly. The Pt/Ir electrode elevated over flat surface and that after putting gas permeable membrane protect biological sample against leakage.

Instruction for manufacturing of H_2 micro-cell.

1. In machine shop make plastic parts.
2. Prepare Pt/Ir disk with soldered Pt wire (using pure Ag and flux – sodium borate; melting point ~950^{o}C; propane torch).
3. Soldering of Copper wire (AWG 26 or so) to (1) Pt wire and (2) to silver wire (99.9 %; d = 0.4, l = 80 cm) with using common Sn/Pb (60/40) solder.
4. Insert Pt/Ir and Ag electrode and fill all canals in epoxy glass body by water-resistant marine epoxy glue.
5. Hardening at 60-70^{o}C overnight.
6. Wrap silver wire around corresponding epoxy glass portion (d = 5.5, l = 17 mm) up to two layers.
7. Cover silver wire by Teflon tape for protection from dirty at sanding of Pt/Ir electrode.
8. Sanding and polishing of Pt/Ir surface (with plastic surrounding) to sphere diameter about 20 mm.
9. Cutting access of plastic around Pt/Ir electrode. Fitting of top delrin body and adjustment of Teflon cover.
10. Making connector on the side of delrin body.