Underwater Raman Sensor for IED Detection

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Full view of the underwater Raman sensor inside a pressure case mounted on an optical bench. Where laser = TID-532 green pulsed laser; ICCD – mini intensified charge-coupled device (ICCD) camera; RS = Raman spectrograph (custom F/2); BE = beam expander; MCL = mirror camera lens (telescopic Bower 500 mm, F/8 lens); and a custom scanner. Laser beam is shown as solid green line.
Cyclohexane, 532 nm, 20 Hz, 12 mJ/pulse, 1 s at 2.5 m distance
(a) Underwater Raman sensor at University of Hawaii Marine Center

(b) Underwater Raman sensor being prepared for underwater deployment showing three targets mounted at the end of the Raman sensor, where GYP = gypsum (CaSO$_4$·2H$_2$O); KPCl = potassium perchlorate (KClO$_4$) and AN = ammonium nitrate (NH$_4$NO$_3$).
(a) Remote operation of the Raman sensor via remote desktop on the laptop computer

(b) Video image of the 532-nm laser spot on the middle underwater target
Raman spectra of the Ammonium Nitrate target in air, of seawater, and of AN immersed in the harbor at 1.5 m from the sensor with 532 nm laser, output pulse energy 11.3 mJ/pulse, gate 80 ns, exposure time 4s, 10 accumulations.