Dewar bottom. Since metal parts over which the tubing is pushed are lubricated with vacuum grease, it slips rather easily. Taking this precaution, the residual force exerted on the sample with no load on the loading platform, with the Dewar evacuated, is less than 2 N. The other end of the steel wire is attached to the yoke also by a set screw. (Use at least #6 set screws for forces up to 1000 N.) The single wire is joined at the yoke with two wires which lead in grooves along both sides of the holder to the anvil (Fig. 2) to which they are silver soldered. A copper heat shield maintained at liquid nitrogen temperature (item 5 of Fig. 1) surrounds the entire holder and only the single wire (item 7 of Fig. 1) extends from the heat shield.

The force is measured by a spring scale which is connected to the loading hook and at the other to a turnbuckle which is bolted to a scaffold attached to the sample compartment of the spectrophotometer. As a safety measure, a stop rod is inserted between the scale and the loading hook to limit the movement in case of breakage. The temperature is measured by a thermocouple attached to that part of the specimen which is outside the path of the optical beam. Lead lining of both the anvil and the seat at the area of their contact with the specimen distributed the stress uniformly. Figure 3 shows a typical uniaxial stress–spectral shift run[4] made on the 9572 cm^{-1} rhombic-I symmetry aggregate defect in 10^{18} n-cm^{-2} irradiated MgO.

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Use of a Linear Staircase Generator in Displaying Synchronized Pulse Activity*

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Measuring the time between a pulse and a synchronizing signal from movie film (as data are obtained from nerve cell action potentials in our neurophysiological laboratory) can be time consuming and laborious. An ideal method of display would show many timed events over a small surface area and in a readily comprehensible fashion. One technique we have employed (Fig. 1) is to apply the amplified event to the intensity modulation input of an oscilloscope (z axis) through a pulse generator. Each event is represented by a dot on the oscilloscope screen. A triggering pulse from the stimulator is used to initiate the horizontal sweep. The sweep rate is chosen such that the total sweep time is slightly less than the interval between triggering pulses. By shifting the electron beam position of the CRO with a linear staircase generator[1] to a new horizontal position before each sweep, masking of previous events is prevented. The voltage output of the staircase generator is applied to the vertical amplifier (y axis). The application of the synchronizing pulse may be during any period of the sampling time.

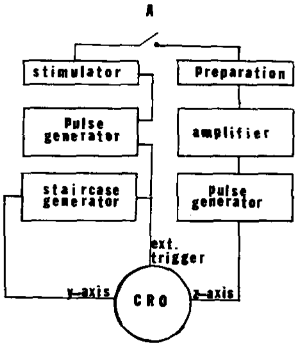

Fig. 1. Schematic illustration of the incorporation of a staircase generator in circuit used to display time intervals. Switch A electronically controls the period of application of the stimulation pulse.

By taking one timed photograph exposure which includes the period before, during, and after application of a synchronization signal (stimulation of the animal), one can quickly compare certain features of intervals between events. Figure 2 illustrates an example of nerve cell discharge activity during an experiment. The cell fires at random with respect to the sweep inititation during the prestimulation 10 sec period from A to B. During the 10 sec of stimulation, indicated by the artifact column

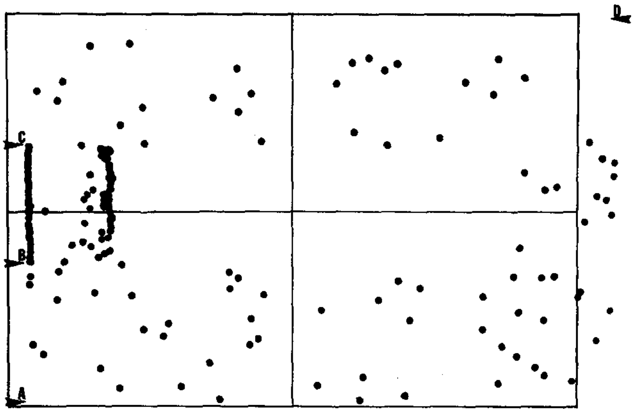

Fig. 2. Reproduction of 30 sec time exposure of oscilloscopic record using a staircase generator and intensity modulation method of displaying neuron discharge activity. Sweep time is 250 msec, occuring left to right. Sample time begins at A and terminates at D after 120 sweeps. Stimulus artifact is from B to C. Stimulation is slightly less than 4/sec.

between B and C, the response pattern of the cell is altered. After 2 sec of stimulation, the cell responds with a discharge synchronized at an approximate 30–40 msec latency, as indicated by the high concentration of dots to the right of the stimulus artifact. The cell does not discharge during a 150 msec period following the time-locked response. There is a return to the prestimulation pattern during the post-stimulation period C–D.

Repeating events synchronized with respect to the sweep initiation become apparent by this technique. In addition, the number of events during one or any number of combined sweeps may be determined. The limit of the number of sweeps across the CRO is determined by the size of the voltage steps (600) of the staircase generator. The total possible sampling time depends upon the frequency and size of the steps.

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Temperature Tunable Laser Diode Spectrograph

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HIGH resolution spectrographs over a limited scanning range can be constructed with tunable monochromatic sources. This note describes an absorption spectrograph employing a GaAs laser diode which is temperature tunable between 840 and 870 nm. Recently available GaAs lasers operating at room temperature extend the spectral range to 900 nm. Semiconductors suitable for other spectral ranges are listed in a review article of Nathan.[1] Although pressure tuning permits the coverage of a wider spectral range,[2] technological problems in generating the required pressures are severe. The laser diodes we used were grown[3] by liquid epitaxy with donor and acceptor concentrations of 1.7×10^{19} Te/cm^3 and 2×10^{19} Zn/cm^3, respectively, and were subsequently heat treated at 900°C for 75 min and cut into Fabry–Perot cavities.

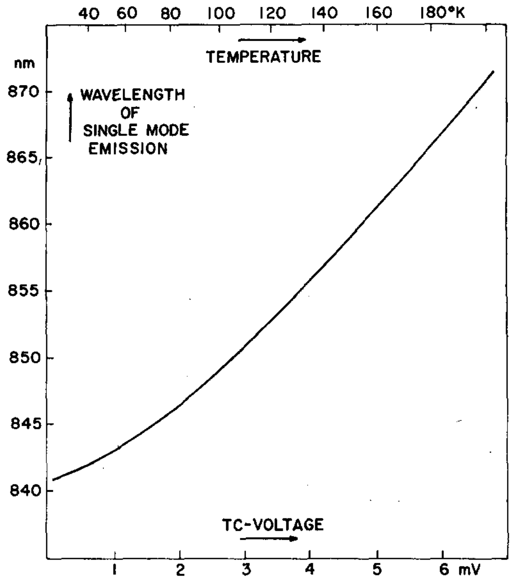

Fig. 1. Temperature dependence of the spectral peak of single mode emission from a GaAs laser. Temperature and the respective thermocouple voltage are shown on the X axis.

At certain temperatures just above the threshold current, the stimulated emission occurs in one single mode, the spectral position of which is determined by the temperature of the laser crystal and by the modes of the Fabry–Perot cavity. A continuous temperature variation causes the laser light to sweep through adjacent cavity modes sometimes giving rise to double mode emission. The mode spacing is approximately 0.4 nm, the spectral half width of single and double mode emission is less than 0.2 and 0.6 nm, respectively.

Figure 1 shows temperature dependence of the wavelength of single mode emission from the GaAs laser diode specified above. In general, the dependence above 100 K is similar for all GaAs laser diodes but below 100 K fabrication methods cause an appreciable deviation. It has been found that epitaxially grown diodes with a long interdiffusion time of the p–n junction cover a wider spectral range than diodes with a short interdiffusion time, where tunnel effects[4] account for the temperature independence of the stimulated emission between 8 and 60 K.

It should be noted that the threshold current depends on the third power of temperature and that currents far above threshold generate several modes thus destroying the spectral purity. Therefore, to maintain single mode emission at any temperature, it is necessary to apply a control loop for the injection current. It has been found that the emission intensity in single mode operation is independent of temperature. Hence, the injection current at different temperatures must be adjusted for constant emission intensity which assures single mode operation. Injection currents at low repetition rates are required to prevent excessive heating of the junction. The discharge of a capacitor gated by a SCR generates short current pulses which are injected into the lasing junction.