the gauge while maintaining small lateral dimensions.[29] It is desirable of course to keep the thickness as small as possible in order to increase the inherent time resolution, which is dependent on the reverberation time through the thickness. Small lateral dimensions are also desirable to minimize losses in time resolution due to tilt of the wavefront with respect to the plane of the gauge.

An example of one such grid is shown in Fig. 6. This gauge was photoetched from manganin sheet rolled to 0.00075" thickness. The lateral dimensions of the active element are 1/8" and the resistance is about 1.5 ohms. This gauge has four terminals in order to use a bridge method for recording the resistance changes. With the bridge method and a constant current power supply the effects of stretching of the current or voltage leads due to edge effects is minimized.

When the sample to be investigated is an insulator a gauge of this type can be inserted directly into the sample with only a very thin layer of cement to fill the voids between the grid elements. If the sample is a conductor, however, thin insulation must be added to prevent premature shorting. Insulating materials such as mylar, mica, glass and Lucalox have been employed. Of these, Lucalox is attractive because it has high electrical breakdown potential, and it has high shock impedance so that the impedance match with metals is improved over, say, mylar.[27] Because of its low compressibility the change in capacity between the element and the sample is also minimized. A disadvantage is that fabrication of thin films is difficult; plasma sprayed films are one possible solution.[29]

The time resolution of these gauges when used in metal samples is somewhat poorer than the time resolution of quartz gauges, for example, principally because of the insulation thickness. If the total gauge thickness including insulation is several thousandths of an inch and several reverberations of the pressure pulse are required to establish equilibrium between the gauge and the sample, the time resolution can be of the order of 30-50 nanoseconds.

Recording durations of gauges of this type are normally several microseconds, and for laboratory use are generally larger than the times for which one-dimensional flow can be maintained. Careful treatment of the leads is important for longer recording times since shearing of these is the usual cause of premature failure.

Experiments with vapor plated manganin grids and with other materials such as calcium, lithium and ytterbium show considerable promise for improving the low pressure sensitivity of gauges of this type.[30] Calcium, for example, exhibits a pressure coefficient roughly ten times as great as manganin at pressures at least up to 28 kbar. However, it has much higher temperature sensitivity.

An interesting variation on this method has been reported by Bernstein, et al.[31] They have used two manganin grids oriented respectively in planes parallel and perpendicular to the direction of propagation. Each grid measures the stress component normal to its plane so that the difference in signals is a measure of the effective yield stress.

2. Electromagnetic Velocity Gauges

When the sample to be studied is an insulator an electromagnetic technique can be used to measure mass velocities directly. This technique was first used to measure detonation parameters in explosives. Its use in inert solids was first reported by Dremin who used it to determine the behavior of glass under shock loading.[32] Ainsworth and Sullivan have also reported extensive measurements on rocks up to 30 kbar.[33]

The idea is that a fine wire or foil imbedded in an insulator develops a potential difference when it moves in a magnetic field. Thus, to the extent that the foil motion is the same as that of the insulator, a measurement of the voltage across the wire can be related to the mass velocity of the insulator.