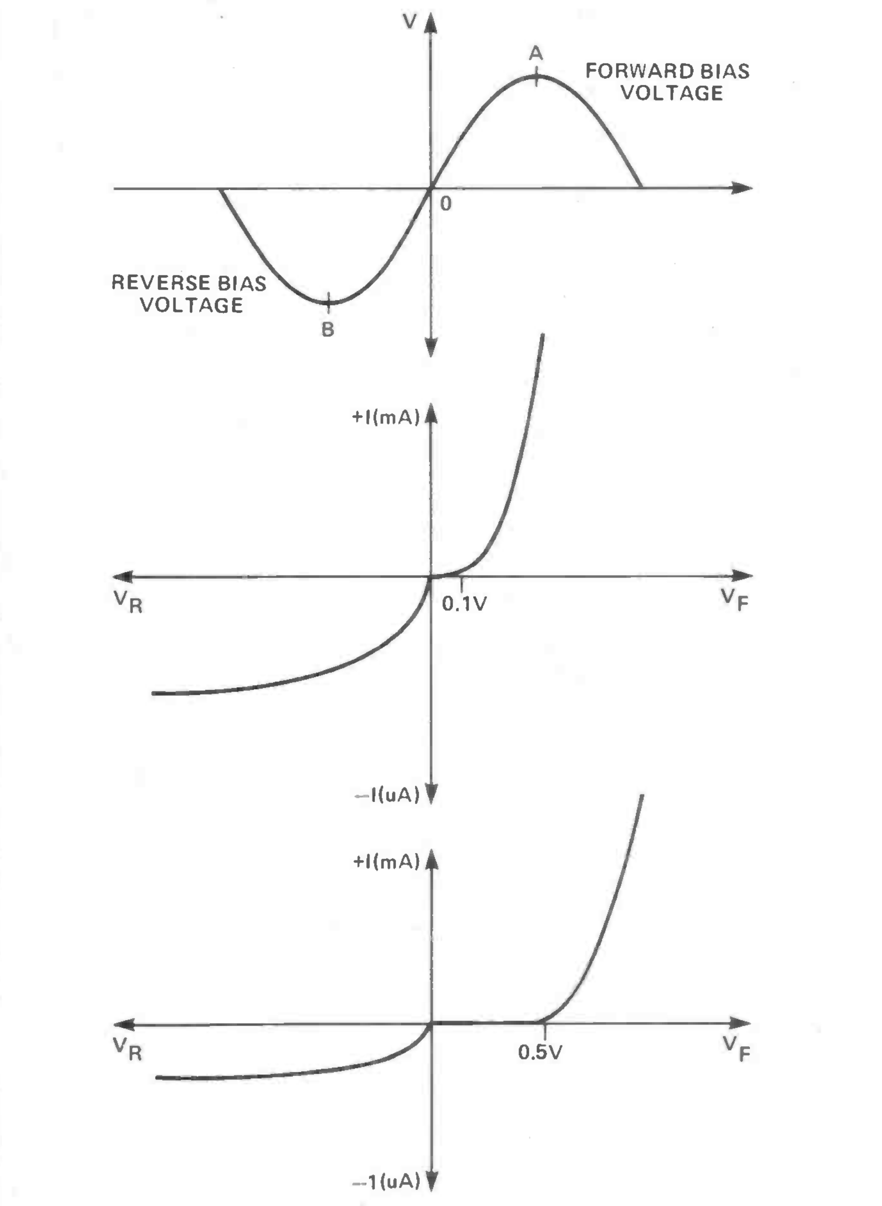

Fig. 9(a) Sinusoidal wave applied to a diode; (b) germanium diode characteristics and (c) silicon diode characteristics; note the different scales for the positive and negative currents in both of the characteristic graphs.

ed their **lifetime**.

During their lifetime the stored minority allow current to continue flowing, so conduction actually ceases some time *after* the diode is no longer forward biased. In diodes for use at radio frequencies it is necessary to reduce storage time so that it will not cause circuit performance to deteriorate. It can be controlled by suitable processing of the semiconductor.

Reverse Or Leakage Current

Thermal generation of free electrons is a continuous process in a semiconductor, as we've already seen. If a diode is reverse biased, so preventing conduction (or current flow across the junction by majority carriers), it will not prevent electrons thermally generated on the p-side (as minority carriers near the junction) being attracted over into the n-side – or prevent holes diffusing over from the n-side to the p-side of the junction. So a small minority carrier current will flow through the circuit. This current is variously known as the **leakage current**, the **reverse saturation current** or simply the **reverse current**.

This reverse current flows in the opposite direction to the majority carrier current of forward bias. Since it is caused by thermal effects, it is essentially constant in amplitude for any given temperature, regardless of the reverse bias voltage applied.

The reverse current doubles approximately for each 10°C rise in temperature (slightly less in silicon but more in germanium). The leakage current at a fixed temperature is about 100 times as great in germanium than that in silicon. Hence the preference for silicon where small leakage (reverse) current is an important factor.

Diode Characteristics

To plot the characteristic graphs of the diodes we consider the effect on the current passing through the diodes of voltage increasing from zero as forward bias and decreasing from zero under reverse bias.

First we'll consider the effect of increasing the forward bias voltage from zero to the maximum (at A of the sinusoidal voltage waveform). For the germanium diode current won't start to flow until the voltage applied reaches about 01.V, then it will gradually increase until the space charge voltage is reached – when it will start to increase very fast, and continue in this way.

For the silicon diode, current takes much longer (by comparison) to start flowing. The voltage required being about 0.5V, at which the current gradually starts to flow – increasing slowly until the space charge voltage is reached and then increasing rapidly.

Almost the opposite occurs when the diodes are reverse biased, during the section of the sinusoidal input cycle that has B as its low point. Here, as the voltage becomes more negative, the reverse current builds up rapidly towards its maximum value (although this maximum value is very small in comparison to the forward currents), then rises very slowly after this, in fact just edging closer and closer to this never-quite attained maximum.

If a very high voltage were applied to an ordinary diode, it would cause the diode to break down, and a very large reverse current would flow for the remaining few microseconds of the diode's life!

In the charactersitic graphs of Fig 9(b) and Fig. 9(c), note that the larger current flow under forward bias voltage V_f is measured in mA, while the much smaller reverse current under reverse bias voltage V_r is measured in the much smaller measuring unit of A.