EP04 the characteristic curve of the semiconductor diode

Ohm's Law is the following statement: "The resistance of a particular circuit element is constant for a wide range of voltage." Unlike many physical laws (such as Newton's Laws, the Ideal Gas Law, etc), Ohm's Law does not always hold, even under ordinary laboratory conditions. Certain objects obey Ohm's Law, and others do not. The physical size and shape of an object, as well as the material it is made of, can determine its adherence to Ohm's Law. For instance, a large block of material is more likely to be ohmic than a fine wire made out of the same material. In a sense, Ohm's "law" is really Ohm's guideline.

OBJECTIVE

To examine how current varies as a function of voltage for a semiconductor diode, and to plot the corresponding I ~V curve in forward and reverse bias.

THEORY

In this lab, you will measure the characteristic curve of the semiconductor diode and you will know whether the components obey the *ohm's* law

Using one of the circuit diagrams described later(Fig.2),the p.d *V* across a component can be varied and the corresponding current *I* measured. A graph of *I* against *V* shows the relationship between the two quantities and is called the characteristic curve of the component. It summarizes pictorially how the component behaves.

If the *I-V* graphs are straight lines through the components, the ones are called linear or *ohmic* conductors(Fig.3).For them $I \propto V$ and it follows that $V/I=C$ (*C* is a constant). They obey Ohm's law. If their *I-V* graphs are not straight lines or that $V/I \neq C$, the components are *non-ohmic* or *non-linear* conductors. A diode is a *non-linear* component, and its typical *I-V* graph is showed in Fig.4.

The semiconductor diode (symbol⊣▷⊢) is an interesting circuit element. Diodes are designed to pass current in only one direction. They are essential in many electronic devices, such as rectifiers, which turn AC currents into DC currents. Our diode was formed by joining two different types of semiconductor together. Diodes that are connected in the direction of current flow are said to be connected with "forward bias," while those hooked up to oppose current flow are in "reverse bias." This can be shown on a circuit diagram as in Figure 1. You can think of the triangle in the diode symbol as pointing in the direction of allowed current flow.

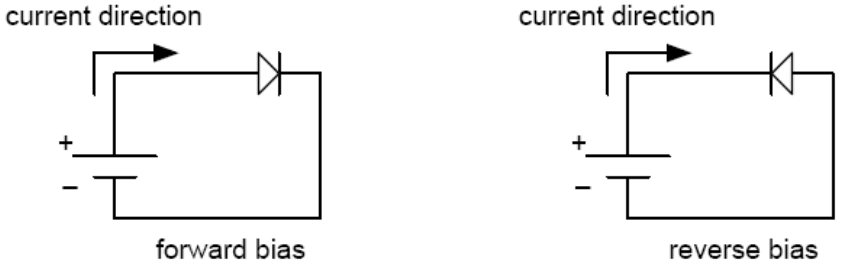
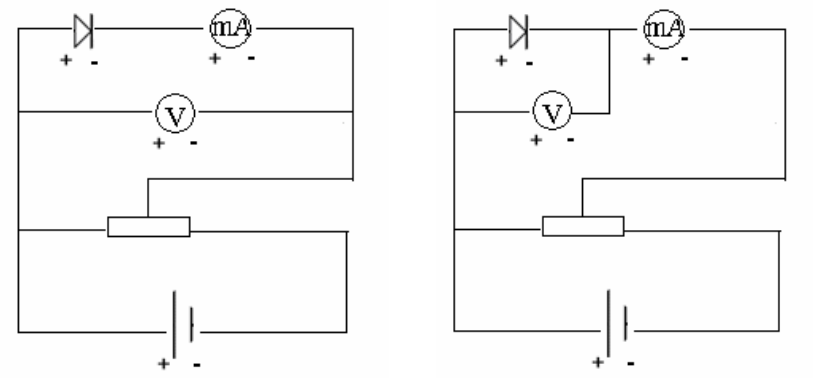


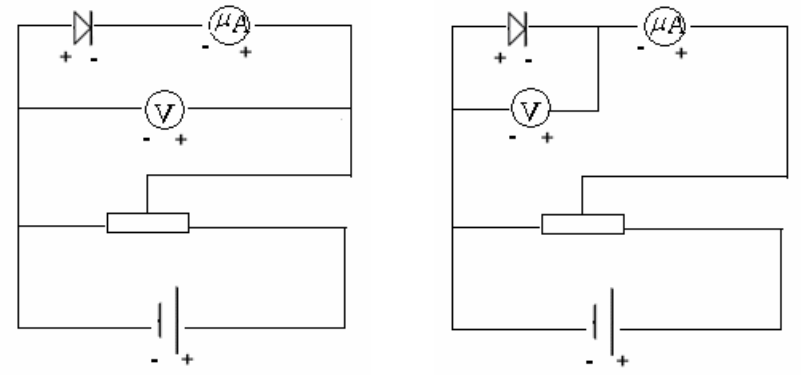
Fig 1. Standard circuit diagrams showing a battery(or other DC voltage source)and a diode in forward bias and reverse bias.

To study the characteristic curve of the semiconductor diodes one has to measure both V and I at the same time. There are two possible circuits to choose for forward bias and reverse bias.

"+"sign and "–"sign specify the directions of voltage and current in the semiconductor diode.



(a)　　(b)



(c)　　(d)

Fig .2 Circuit diagrams Circuits in experiment

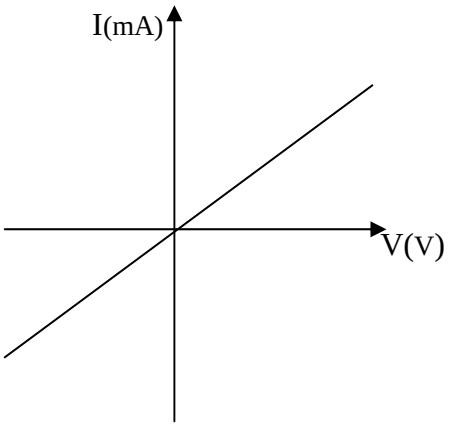


Fig.3 I-V curve of linear conductor

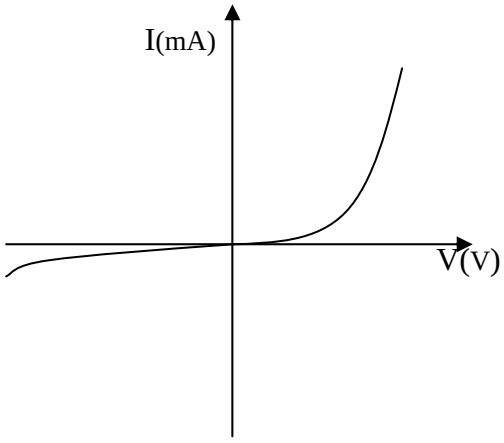


Fig.4 I-V curve of a diode

PROCEDURE

A. Measure resistance R1 of the semiconductor diode in forward bias and resistance R2 in reverse bias using the ohm's setting of a multimeter and write down them, then judge if the diode can work normally. This must be done before you build any circuits.

B. in forward bias, build the circuit like Fig 2(a) or Fig 2(b), vary the sliding contact of the variable rheostat from zero, measure the Voltage *V* across the diode and the corresponding current *I* .
Complete table 1.

C. in reverse bias, build the circuit like Fig 2(c) or Fig 2(d), vary the sliding contact of the variable rheostat from zero, measure the Voltage V across the diode and the corresponding current I .

Complete table 2.

PRE-QUESTIONS

what do you think the voltage, current and resistance would change if you switch the positive and negative cables at the power supply? Write down you prediction.

DATA RECORDING AND PROCESSING

(A) Write down R_1 and R_2

R_1=_____, R_2=_____

(B)

Table1 current-voltage in forward bias

I(mA)										
V(V)										

(C)

Table2 current-voltage in reverse bias

I(mA)										
V(V)										

QUESTIONS

1. Make a titled, labeled graph of voltage versus current what is the relationship between the current through the diode and the voltage drop across the diode in forward bias and reverse bias state.

2.Describe the diode's behave qualitatively. Dose it obey ohm's law? Can you think of anything a diode would be useful for?