Amorphous Semiconductors

In two recent Research News articles on amorphous semiconductors (26 Aug., p. 851; 9 Sept., p. 1068) there is no direct mention of a feature that is important for both a fundamental understanding and device applications of the most commonly studied of these materials. Namely, their electrical transport properties appear to be quite distinct from those characterizing well-known crystalline semiconductors such as germanium and silicon. In particular, while the charge carriers in these crystals move rapidly, the intrinsic motion of charge carriers in many amorphous semiconductors appears to be extremely slow. For example, at room temperature the mobility of electrons in crystalline germanium is between 10^3 and 10^4 square centimeters per volt-second, while in amorphous germanium it is found to be about 10^{-3} square centimeter per volt-second (*1*). My review (*2*) of experimental evidence from a variety of laboratories indicates that such low intrinsic mobilities characterize amorphous silicon and germanium, the chalcogenide glasses, and transition metal oxide glasses.

One dramatic indication of the difference between the mechanism of charge transport in these amorphous materials and that in the high-mobility crystals is encountered in measurements of the Hall coefficient. In high-mobility crystalline semiconductors the sign of the Hall coefficient is the same as the sign of the predominant charge carrier. However, in the chalcogenide glasses and in amorphous silicon, germanium, and arsenic, the sign of the Hall coefficient is observed to be opposite that of the charge carrier (*2*).

It should also be noted that, in considering devices such as solar cells, the diffusion length in an amorphous semiconductor can be very much shorter than in a high-mobility crystalline semiconductor. It is only 3×10^{-6} centimeter in amorphous germanium (*1*), compared with about 10^{-2} centimeter for the silicon commonly used in solar cells. These short diffusion lengths are likely to affect the design of practical electronic devices.

DAVID EMIN

Sandia Laboratories, Albuquerque, New Mexico 87115

References

1. T. D. Moustakas and W. Paul, *Phys. Rev. Sect. B* **16**, 1564 (1977).
2. D. Emin, two papers presented at the 7th International Conference on Amorphous and Liquid Semiconductors, Edinburgh, 27 June to 1 July 1977; W. Beyer and H. Mell, paper presented at *ibid.*; P. G. LeComber, D. Jones, W. E. Spear, *Philos. Mag.* **35**, 1173 (1977); D. Emin, *ibid.*, p. 1189.