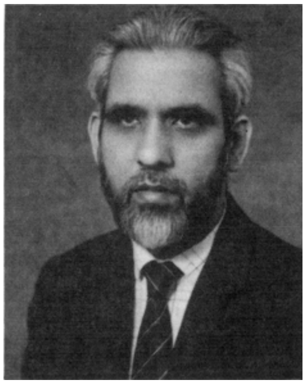
Commentary



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All technological interest in materials is somehow related to the structure of materials, which determines their properties. Most of these materials, both in nature and in commerce, are polycrystalline and often consist of grains of various shapes, sizes, and phases. If these grains are uniformly distributed throughout the bulk, this state is known as the random state. Otherwise, it is said to possess preferred orientation or texture. Physical and mechanical properties of a random solid are isotropic. However, this is not true for the materials possessing texture. Texture introduces directional (anisotropic) properties, and these may be very different from those of the corresponding random aggregate. Indeed, the properties of the oriented materials may even be objectionable. Therefore, knowledge of the preferred orientation or texture of a polycrystalline sample is frequently of fundamental importance in science and industry.

During the processes of forming and/or growth or mechanical preparation, materials may become oriented preferentially along certain crystallographic (*hkl*) planes or directions. Crystalline rocks and minerals commonly develop orientation or texture during crystallizing from the melt or during metamorphosis. Natural and artificial fibers also exhibit orientation texture as a result of long chain-like molecules orienting during growth or manufacture. Mechanical operations such as drawing, stretching and rolling, performed on fibers and polymeric materials may increase these orientation effects. Cold-drawn wire and rolled metal sheet exhibit strong preferred orientation and texture. If a metal is heated during such forming operations, annealing and crystallization textures may also result. Cast metals develop oriented grains perpendicular to the walls of the mold, and metal films from electropolishing, vacuum evaporation, and sputtering exhibit special textures.

Texture may occur through several means, such as slip, twinning, cross slip, and kinking, etc. During forming, the dimensional change in the specimen is accompanied by plastic deformation of the metal through cleavage and slip of the grains. This slip or gliding usually occurs along the crystal planes that are most densely populated with atoms. In random materials, these gliding processes not only fragment the metal grains, but also tend to rotate them so that they take up preferred orientations with respect to the drawing or rolling directions. In cross slip, the movement of the sliding planes in a direction opposite to that of the slip is caused due to some sort of obstacle in the direction of the slipping planes. Because of this, a backward/reverse movement of the planes occurs, thus helping some planes to increase in population. Kinking is a complex combination of slip. In this situation, kinking or bulging like corrugated sheet may also cause texture.

Wire drawing offers the simplest kind of texture. The situation in rolled sheet is more complicated. In this case, the sheet is elongated, mainly at the expense of its thickness. Two types of texture arise in this treatment—alignment parallel to the rolling direction and parallel to the surface of the sheet. The particular planes and directions thus oriented are characteristic of the material and the parameters of the cold work. The texture in a rolled sheet is not necessarily uniform throughout the bulk material and may differ considerably from surface to interior.

Thus, texture is dependent on the crystal class or symmetry to which the material belongs, and its detailed description may be made through an orientation distribution function (ODF). This method of texture measurement is relatively new and offers certain advantages over the conventional direct-pole figure technique, but demands highly accurate data and a large number of pole figures as input. Furthermore, the ODF technique provides a texture map with respect to a particular direction, i.e., rolling and/or normal direction, and it provides information about the type and quantity of texture.

Finally, it should be emphasized that *knowledge of texture in materials is of utmost importance.* It may lead to the development of new materials manufacturing processes, as is the case with electrical steel or magnetic materials, so that one may obtain commercial products with a particular texture. Knowledge of the texture of materials can also reduce failures, thereby saving cost and improving safety.

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