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Editorial

The Fibrous Form Confers Unique Properties on Materials

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The main distinguishing feature of the fiber is simply that it is a particle where the ratio of length to width ratio is very large. This provides connectivity between two relatively remote areas. Such linkage may confer strength through physical linkage or may relate primarily to information transfer. In the inorganic world, fibers can originate as a result of the process by which the solid material is condensed from the corresponding liquid form. Man-made fibrous materials are essentially polymers of a single or several molecular species repeated many times, or, in the case of metals, chains of elemental atoms. A host of man-made fibers have been developed in the last 50 years. A large range of uses has been found for these products. These include clothing, upholstery, fiber optic cables, filters, insulation, electromagnetic screening, and boat and aircraft construction.

In contrast, biological fibers often have originated by evolutionary selection and thus they can be said to have a design relating to a specific function. Such roles include building of the cytoskeletons of plants and animals, or the enabling of certain specific processes, such as transport and communication found in nerve fibers, and contractility found in muscle tissue.

The asymmetric nature of fibers forms the basis of several distinctive properties not found when the same chemicals are present as a more circular particle. The most dramatic difference between a fiber and its parent material is its tensile strength. This can be very great, one the strongest being the thread produced by spiders in web construction. This has now been recently matched with a novel synthetic fiber. The strength of fibers can be many times that of the original material. In the case of glass, the tensile strength of the fiber is around 3 orders of magnitude greater than that of solid glass.

Other, less desirable properties can also be manifest in the fiber form as opposed to a more spherical particle shape. Natural fibers occur in many mineral types such as asbestos. Elongated asbestos particles can induce inflammatory disease and mesothelioma following inhalation. The exact geometry of each type of asbestos mineral plays a significant role in determining the extent of its harmfulness. The crocidolite form of asbestos is much more closely associated with mesothelioma than is chrysotile which is much less asymmetrical.

Very fine fibers share some properties with nanoparticles, in that both have a very large surface area per unit weight. This can lead to absorption and superficial accumulation of metallic ions whose valence flux can promote the production of harmful reactive oxygen species. In the case of asbestos fibers this property can amplify the toxicity of the mineral.

The purpose of this editorial is to draw attention to the unpredictability of some of the properties of fibers and to some universal features that they share. It is our hope that the journal will provide a setting for discussion between specialists with expertise in apparently unrelated areas, and that serendipitous interactions will lead to the development of new concepts and approaches to fiber technology. We therefore hope that the journal will be broadly attractive and we would like to solicit articles from a diverse spectrum of skilled and specialized scientists.