Engineering Transport Properties of Fibrous Materials

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Abstract

Fibrous materials have wide applications in many different fields including filtration, fuel cells, thermal insulation, paper products, medical science and apparel. In most of these applications, fibrous materials serve as media, through which air, vapor, particles, heat or electricity pass through. It is therefore essential to understand the transport phenomena within fibrous media so as to optimize the transport properties of fibrous materials for specific applications.

In this presentation, the principle mechanisms of different transport phenomena in fibrous media as well as their interactions are explained. The effects of various material parameters on the transport properties are discussed. Specific models for heat transfer through penguin feathers and water transport through branching tree network are presented. The theoretical understandings are applied to develop new fibrous materials for functional clothing. Furthermore, the presentation also introduces some novel instruments developed in our group to characterize the heat and mass transport properties of fibrous materials and clothing ensembles.